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THE CHANGE FROM THE OLD TO THE NEW BOTANY IN THE UNITED STATES[1]

IT is generally known that in the seventies there was a sudden development of the study of botany in this country. Just how and why this sudden development took place at that particular date is, I suspect, not clearly recognized, at least by our younger men. From histories and reports of progress they can learn the main facts, but those who, as students or instructors, have lived through the transitional period when the old botany was changed into the new are in a better position to appreciate the underlying causes. There are, however, few such persons still living and the small number is not wholly due to the normal death rate. The relative number of botanists was smaller then than now and it will not do to assume that this was owing solely to the lack of attractions in the botany of the day. The main reason was that one could hardly expect to earn a living as a botanist. When I graduated from college in 1866 and wished to become a botanist, Professor Gray told me that I ought to study medicine first because the possibility of gaining a living by botany was so small that one should always have a regular profession to fall back upon. In fact, at that time medicine was practically the gate through which it was necessary to pass in order to enter the field of botany. Some years later De Bary told me that, when he was a young man, there was a similar state of things in Germany and, although desiring to devote himself to bot-

[1] Address of retiring president of the Botanical Society of America, given at the Botanists' Dinner, Cleveland, January 1, 1913.

any, he had to study medicine, taking his degree in 1853. In 1872, however, things had changed in Europe and when I went to Strassburg to study I was the only student in De Bary's laboratory who had studied medicine. The others had begun the special study of botany on entering the university and were, although no older than I was, much better trained in botany.

In 1866, there were very few botanical professorships in this country, the salaries were very small and the equipment very shabby. Gray was professor at Harvard, D. C. Eaton at Yale and Porter at Lafayette. Torrey, in spite of his distinction as a botanist, really depended on his position as a chemist for his living. The comparatively few positions in government and state stations offered few attractions and changes were frequent. To a young man the prospect was not assuring.

If we look further and ask what was the attitude of the public towards natural science, we find a state of things very difficult to appreciate at the present time. This can be illustrated by my own experience as a school boy. When I was in the high school one of the books we had to study in the upper classes was Paley's "Natural Theology." You may perhaps infer from this that the object was to give us religious instruction. Not at all. The real object was to smuggle a little human anatomy into the schools. This was the way it was done. Very few of you probably ever heard of Paley's "Natural Theology," in its way a remarkable book. In the opening chapter Paley supposes that a man walking in the fields finds a watch on the ground. He sees the complicated machinery adapted to a definite purpose and therefore, according to Paley, at once infers that it must have had an intelligent creator. How much more strongly, therefore, should a contemplation of the organs of the human body, well adapted to perform special functions, lead us to believe in the existence of an intelligent creator. Paley then proceeds to give a rather mild account of human anatomy illustrated by plates intended to impress the readers; a ghastly head with the cheek dissected to show the parotid gland; an abdomen with the lid removed to show the bonbons inside, the stomach and spleen ingeniously arranged so as to show also the deeper lying organs, etc. Paley's reasoning does not now seem altogether convincing. If you or I had found the watch, we should have seen that it was complicated and we should have known that its purpose was to show the time of day. We should have known also that it had been made by a watchmaker. If, however, a savage who had never seen or heard of a watch had found one in the field, he would have been mystified by the mechanism and would not have had the least idea what its purpose was. Instead of recognizing an intelligent creator he would have regarded the watch itself as a god.

Now, at the time of which I am speaking, it would not have been proper to teach anatomy *as such* in the schools, but anatomy, so far as it served to show the goodness and intelligence of the creator, was quite legitimate. In other words in studying natural history one must never forget that God had made man to be the center of the universe and all other things had been arranged for the benefit of man, and, when facts to the contrary appeared, they must be properly interpreted or denied. Since an omniscient and omnipotent being can not make a mistake, all the species of plants created in the beginning must forever remain as they were created. With this simple theory of living things people were perfectly contented until in 1859 the "Origin of Species" fell like a bomb in

the camp and shattered time-worn theories. That the variations and adaptations of plants and animals were not for the benefit of man, but for the benefit of the plants and animals themselves, was a dreadful heresy. The violence of the controversy caused by Darwin's great work was something of which the present generation can have no conception. It was at its height when I was a college student. Young men were generally inclined to accept Darwin's views, and in our college natural history society most of the meetings were spent in discussing evolution. Some of us had really read the "Origin of Species," but all were ready to talk about it. The older men, even the naturalists by profession, were much more conservative. A few adventurous spirits were more Darwinian than Darwin himself, but college professors had to be careful in what they said, for practically the whole religious world and the greater part of college graduates were not ready then to accept evolution. The bitter feeling of the antidarwinians continued for a considerable number of years, as is shown by the following instance. A little more than twelve years after the appearance of the "Origin of Species" one of our leading universities wished to appoint a professor of zoology. The place was offered to a friend of mine with the stipulation that he should never, directly or indirectly, refer to evolution in his lectures. As my friend was one of the most rabid evolutionists in America, the conditional offer seemed amusing. He, of course, declined and the place was then offered to one hardly less radical in his views, and was again declined. It was rumored that the place was offered to a third person and again declined, but I have no direct knowledge that this was the case. The present incumbent, I presume, believes in evolution, but probably no one has ever taken the trouble to ask him whether he does or not for, at the present day we should no more think of asking a professor of zoology whether he believes in evolution than whether he is the fortunate owner of a tooth-brush.

At a time when many of the leading zoologists, including Louis Agassiz, were strongly opposed to Darwin's views, the botanist, Asa Gray, exerted a powerful influence in converting the public to the doctrine of evolution. His simple and attractive style enabled him to reach an audience which would have been repelled by the dryness generally supposed to be characteristic of scientific writings. He was also known to be a member of the orthodox church and the good religious people of the country said: if the orthodox Gray sees in evolution nothing inconsistent with revelation, why may we not also accept it? Furthermore, Gray did not go too far in his views, whereas some of the evolutionists started off on a wild sea of speculation whither the public would not be expected to follow.

Having tried as far as the limited time allows to give you an idea of the attitude of the public towards natural science, at the time when I began the study of botany, a word may be said about the botanical instruction in colleges. At Harvard botany was a required study for the whole class during half of the sophomore year. The text-book was Gray's "Structural Botany." Gray had no assistant. To require botany of a whole college class—I am not speaking of agricultural schools—is enough to condemn it to neglect and abuse. This, however, can be said of college students. If their instructors do not interest them they are always able to amuse themselves. In the corner of our lecture room was the trunk of a palmetto which had been used to grace the funeral procession of Calhoun

and afterwards given by Professor Gibbs to Gray as of historical as well as botanical interest. It was the duty of the athletes while the attention of the instructor was diverted to seize the trunk and carry it to the entry and later on to start it rolling down the very winding staircase. This method of studying botany I discovered later was not confined to Harvard. Once while visiting a western university I noticed, to my surprise, a cannon ball back of a door. I asked why it was there and was told, not by a student, but by the instructor himself, that during the lectures the students rolled it along to the head of the staircase when gravity was left to do its perfect work. Afterwards some attention was paid to the lecturer, and how much was learned on any one day depended on how early in the hour the cannon ball was started on its way. Compulsory botany was not a success. In my junior year eight or ten students who really wished to study botany asked Gray to give them some instruction in systematic botany during the season when fresh material could be obtained. The work on our part was entirely voluntary and in addition to our regular work. It was not recognized by the college and we received no credit for it in the rank list. The number of voluntary workers was reduced to two in my senior year, when we had so much regular work as to leave almost no spare time. I have noticed in recent years a growing disposition to demand some reward in the shape of a degree or a certificate of some kind for any work done outside the regular curriculum. To do work for the pleasure of adding to one's knowledge is, I regret to say, getting to be a sign that one is not up to date.

On graduating I followed Gray's advice and entered the medical school, hoping sooner or later to be able to return to botany. The opportunity came in 1870 when Gray returned from Europe. During his absence Horace Mann, Jr., who had been taking his place, died and I was then appointed assistant. I was always interested in cryptogams and, had it been possible for me to do as I pleased, I should never had studied anything but marine algæ during the rest of my life. It became my duty to arrange the thallophytes of the Gray Herbarium and the work I did was radical, I assure you. Not knowing that Littleton Island was near the North Pole, but supposing it to be somewhere in Long Island, I arranged into the waste-paper basket a number of rather shabby-looking algæ which I afterwards discovered to my mortification were very rare. It did not take long for me to find out that, whatever professors of pedagogy may say, one can not teach a subject without knowing something about it. But where was I to go to study cryptogams? It was proposed that I should study fungi with M. A. Curtis, but he died in 1872. For marine algæ I had to depend on Harvey's "Nereis" and J. G. Agardh's "Species," works which were not easily followed by a beginner, with occasional reference to the by no means exhilarating "Micrographic Dictionary."

Evidently, I must go to Europe, and Germany was the country whose universities offered the greatest facilities for my purpose. The most promising were those of Strassburg, where De Bary was professor, and Wuerzburg, where was Sachs. I chose the former rather at a venture. The other botanists there were Solms and Fr. Schmitz, then a very young man whose work had been in histology. The venerable W. P. Schimper, the bryologist and paleontologist, whose valuable herbarium had been given to the university before the Franco-German war, remained in charge of it and gave a course of lectures. My fellow students were Stahl, Rostafinski,

Gilkinet, Suppanetz, an Austrian, Kamienski, who recently died at Odessa, Karl Lindstedt and Doelbruck, who died young. I learned that I was not the first American who had studied with De Bary. A short time before, while he was professor at Halle, an American, T. D. Biscoe, had taken a course in botany, although not studying botany as a specialty. The only information I have in regard to Mr. Biscoe is that he published a paper on the winter state of our duckweeds in the *American Naturalist* of 1873. There was only one other American, a law student, at Strassburg when I arrived there, for, to the surprise of my fellow-botanists I was not willing to acknowledge as a fellow-countryman a Chilian, whose principal occupation seemed to be duelling and whose English vocabulary was limited to the two words, "damn Yankee."

The general arrangements at Strassburg were the same then as those of other German universities at the present time, but the method of working in the laboratory was very different. I was given a *Chara* to study and in a couple of hours reported that I had studied it. I was told that I had not even begun. Studying, it seems, meant that I must make sections through the scheitel and trace the successive cell-formations. But how was I to make a section and what was a scheitel? The microtome and modern methods of imbedding were then unknown to botanists and all sections had to be made by hand. The nearest approach to imbedding was in sectioning small objects like pollen grains; a few drops of mucilage were placed on a cork, the pollen mixed with it and the whole allowed to harden. Then by holding the cork in one hand one could make sections of the pollen if one were lucky. The student of the present day, when hand-sectioning seems almost a lost art, does not realize what skill in sectioning could be acquired by practise, but, like playing on a musical instrument, constant practise was needed to keep one's hand in. Modern technique, which was borrowed by botanists from the zoologists, has of course many advantages, especially in cytological work, but, for certain work, hand-sectioning has its advantages, as, for instance, the rapidity with which sections can be made.

If I was fortunate in my fellow students at Strassburg, in one respect I was less fortunate. At the time De Bary himself was at work on his "Vergleichende Anatomie," which was published in 1877. Anatomical studies were not his strong point, but, in an unguarded moment, he had promised Hofmeister that he would write the volume for his series and he felt in duty bound to keep his promise. We should have preferred to have had him working on the mycological subjects in which he excelled, but the management of cell cultures and the technique required in such investigations were taught to his pupils. Rostafinski took his doctor's degree while I was in Strassburg, with the thesis, "Versuch eines Systems der Mycetozoen." The monograph of that group did not appear until 1875. I happened to hear De Bary and Schimper talking about Rostafinski's thesis, which they thought was a good work, although they regretted that he had made so many genera. What would they say were they now living, when it almost seems as if we were trying to create a new genus for every species?

In the laboratory I noticed that the students seemed to refer frequently to a book of which I had never seen a copy or even heard. The book was Sachs's "Lehrbuch," second edition, 1870. I bought the book and was perfectly amazed. I had never dreamed that botany covered so large a field. The "Lehrbuch" was an ad-

mirable summary of what was known of all departments of botany up to that date, well written and excellently illustrated. The fourth edition, which appeared while I was in Strassburg, was still better. On looking at the second edition a number of years later, I noticed what seemed to be a curious omission. No mention whatever was made of bacteria. In the fourth edition they are mentioned under *Schizomycetes.* The absence of reference to bacteria in the earlier edition, however, was not an omission. There were no bacteria at that date. There were no bacteria until Cohn published his "Untersuchungen über Bacterien" in 1872. The fact that forty years ago Sachs had never heard of bacteria, while to-day life has almost become a burden, one hears so much about them, is a striking instance of the rapidity of development of a subject having a practical as well as a theoretical value. I know no single book which has had so great an influence in shaping the course of modern botany as Sachs's "Lehrbuch." It may be that the facts there given were generally known in Germany, but they were not known in other countries. On returning home by way of England in 1874, I showed my copy of Sachs to several English botanists and it was evident that it was quite new to them. It was certainly unknown in America. If imitation is the sincerest flattery, the value of Sachs's "Lehrbuch" was quickly recognized, for, using it as a model or basis, there soon appeared a large number of really excellent text-books in various languages in which one recognized Sachs translated, Sachs condensed, Sachs diluted, Sachs trimmed to suit local demands. Publishers, were they capable of gratitude, would have erected a monument to Sachs's memory long ago. Draughtsmen, on the other hand, had little reason to bless his memory. Even now we can hardly open a new text-book without seeing the inevitable "after Sachs."

One evening I was present at a dinner given by De Bary. On that gay and festive occasion I heard more gossip about botanists than one hears even at a meeting of the Botanical Society of America. My neighbors kept saying: "der schmutzige Kerl." On asking who the dirty fellow was, they said Naegeli. In my innocence I inquired what Naegeli they meant. They answered "*Der* Naegeli." Even starch could not save his reputation, and they proceeded to tell not one but many tales which I know you are dying to hear but which I am not going to tell you. What I wish to say is this: At the same dinner some one, possibly Rostafinski, spoke of a certain Strasburger, a botanist. I understood him to refer to some botanist living in Strassburg and asked his name. I was told that he was a Pole named Strasburger who lived not in Strassburg but in Jena and had written a work which showed him to be a promising young man. That was the first time that I had heard of Strasburger, who had not then begun his work in cytology. The promise was fulfilled and the young man of 1873 became one of the bright lights of the botanical world. At the close of his long but too brief career he left a brilliant school in a department of botany which he had created and of which he remained until his death the leading spirit. Fortunately we have with us a younger generation admirably qualified to continue the work which he began.

For the last twenty years most young American botanists have thought it necessary to study in Germany to complete their education, but, when I returned in 1874, I was looked upon very much as one would be who had returned from a journey in Thibet or Central Africa. Things had

changed. The country had recovered from the effects of the civil war, money was more abundant and more could be spent on science. New professors were appointed in the colleges and courses for the instruction of school teachers in botany and zoology were provided by private individuals. I have time only to refer to one curious episode in the development of botany in America. I refer to what may be called the biological epidemic which broke out soon after I returned to America and threatened for a time to drive botany from the field. If at some future time some one ventures to write a book on the abuse of the "ologies" the chapter on biology will be the most interesting. As far as I can make out, as originally used, biology did not differ much from physiology. The laboratory manual of Huxley and Martin was planned to correct the common idea that botany and zoology consisted in the description of different species of plants and animals, whereas in reality they are the study of plants and animals in all their relations to one another and to their surroundings. Huxley and Martin's book was extensively used in this country and was in many ways excellent. The criticism might be made that it was not well proportioned. Without saying that it was all lobster, there was so much lobster and so little of plants that there was not enough to make a good lobster salad. Soon it became the habit of young persons who knew precious little about either plants or animals to call themselves biologists, disdaining to be called botanists or zoologists. It does not follow, however, that because one is neither a botanist nor a zoologist one is to be considered a biologist. Trustees of colleges and similar institutions were given to understand that a superior race of beings had arisen, the biologists, and that botanists and zoologists had had their day. Colleges being always impecunious, this information was gladly received by their governing boards. By calling their zoologists biologists they could escape appointing professors of botany. This clever device for saving a salary worked very well for a few years, but at last it became evident that the teaching by a zoologist with the aid of a text-book, how to distinguish a yeast cell from a fern prothallus and a fern prothallus from a germinating bean, was not all that was wanted in our colleges, although it might have been sufficient in a kindergarten. The epidemic of biology, although it hindered for a time the development of botany in England and America, fortunately never spread to other countries.

Although garrulity is the privilege of old age, I feel that I am still too young to take up more of your time this evening. This occasion, in which the body as well as the soul naturally participates, seemed to me to call not so much for a formal historical account of botany in my day as for a series of personal reminiscences, more or less anecdotical in form, which would throw a little light gained from the experience of one who, although he has lived long, hopes that he has not outlived sympathy with the present, on some of the steps by which our present advanced position among the botanists of the world has been reached. It has been my fortune to see the old order of things overturned by the appearance of the "Origin of Species" which, by freeing science from the fetters of a semitheological bias, opened the way to a free scientific study of the distribution of plants and animals and the great questions of heredity and evolution. To most of you this great change is only a historical fact. To me it is a living memory. I, who was almost the first American student to seek the benefit of botanical instruction abroad,

have lived to see the time when a very large number of our botanists have brought back to America the best that Europe had to offer. There was a time when our botany might have been said to bear the mark "made in England." In more recent years it may be said to have been "made in Germany." There are some patriotic souls who hope that the time will come, if it has not already come, when we may say "made in America." I do not share their feeling. To me it seems that botany is destined to become more and more widely diffused until it becomes world-wide and it will be enough if we contribute our proper share to the general stock. I have lived to see the growth of several branches of botany which practically were not studied at all when I was young. Bacteriology and cytology are of recent origin. Plant physiology has been with us a child of slow growth, but it frequently has been the case that the strongest men have been slow in their development. Plant pathology from a crude and semi-popular beginning has become an exact science in whose study and practical application we have already surpassed other nations. When this society meets forty years hence, I shall not be present. Few of you will be present. But whatever of progress the speaker on that occasion may be able to report will be the result of a gradual development. It can hardly be expected that he will have to record any such radical and complete transformation as it has been my privilege to present to you this evening.

W. G. Farlow

Harvard University

THE SIMULIUM-PELLAGRA PROBLEM IN ILLINOIS, U. S. A.[1]

The advancement of entomology owes much, of recent years, to the stimulus supplied by the discoveries made by medical men with respect to the agency of insects in the transmission of contagious diseases; and just now our knowledge of the species, distribution, habits, life histories and ecology of *Simulium* is progressing by leaps and bounds in consequence of the well-known *Simulium* theory of the transmission of pellagra, announced by Dr. Louis W. Sambon in 1905, and fully elaborated by him in the *Journal of Tropical Medicine and Hygiene* in 1910.

This stimulus to a study of these insects reached me, in one of the interior states of North America, in August, 1910, when, in consequence of the appointment by the governor of Illinois of a state commission for the investigation of pellagra as occurring in the insane asylums and other institutions of that state, I was requested, as the official entomologist of Illinois, to contribute to their report an account of the distribution of *Simulium*, especially in the neighborhood of state institutions in which cases of pellagra were occurring. As an investigation of all insects injurious or dangerous to the public health in Illinois is one of the prescribed duties of my office, I was bound to avail myself, to the best of my ability, of this opportune call. This I did by detailing an assistant, Mr. C. A. Hart, August 8, 1910, to commence observations and collections along the central part of the course of the Illinois River, and especially to make a careful survey of the vicinity of the general Hospital for the Insane, built upon a bluffy bank of that stream near the city of Peoria. My reason for giving particular attention to this asylum was the fact that it had been the principal seat of pellagra in Illinois, containing in 1909 eighty per cent. of the cases of this disease—that is, one hundred and twenty-seven out of two hundred and twenty—recognized that year in the whole state. This bad preeminence has, in fact, been since maintained, this asylum containing sixty-three per cent. of the four hundred and eight cases known to occur in Illinois during the twenty-six months preceding the first of September, 1911.

[1] Read at the Second International Congress of Entomologists, Oxford, England, August 8, 1912.

In the year 1911 but little could be done on this subject; but beginning with April of the present year a continuous program of observations, collections and breeding-cage studies has been steadily maintained and is still in progress on the Illinois River, and a careful survey has been made of the surroundings of the six insane hospitals of the state, and of the almshouse of the county in which the city of Chicago is situated. Cases of pellagra have occurred in all these institutions during the above-mentioned period, but in widely different ratios to the total number of inmates in each—the Peoria asylum, for example, containing, in 1909, twelve times as many cases per thousand inmates as did any other institution in the state. It thus became a matter of special interest to know the facts in detail concerning the occurrence and abundance of *Simulium* in the immediate neighborhood and in the general vicinity of all these institutions.

Besides this work in the field, the insect collections of my office for many years have been carefully examined, and its field notes and accessions records have been sifted for evidence bearing on the species and distribution of *Simulium* in the state at large; and the whole body of the American literature of the subject has been critically studied, with some reference also to a considerable list of European articles.

According to the present state of our knowledge there are approximately seventy species of *Simulium* on record for the whole world, of which we are known to have but fifteen in the United States of North America. Nine species, or possibly ten—the status of one being uncertain—have been found in Illinois, one of which, *S. hirtipes,* occurs also in Europe. No other European species has been found on the continent of North America, although *S. reptans* is reported from Greenland. The slight attention hitherto paid to these insects in America is illustrated by the fact that two of our nine Illinois species—or three of them, if there are ten in the state—are new to science, descriptions of the two known to be new being now in press, under the names of *venustoides* and *johannseni.*[3]

As the state of Illinois extends, from north to south, through five and a half degrees of latitude, there is some difference between its most northern and its most southern districts in respect to the predominant species of *Simulium*; but as all have similar habits, and all but one of them are active biters, this fact probably counts for little in the present discussion.

There is some difference also as to the kinds of waters in which the several species prefer to breed, some of them living mainly in the larger rivers, and others occurring only in the smaller streams; but as the state is well watered in all its parts, and is virtually a level plain, there is no part of it which is wholly beyond the reach of some species of *Simulium.* It is true that these insects are rarely seen in some places, and are an annoying nuisance, and indeed a destructive pest in others, especially along the larger rivers in spring; but since we have found them in considerable numbers at a distance of more than five English miles from the nearest water in which they could have bred, and since there is scarcely a small stream anywhere in some part of which *Simulum* larvæ can not be found throughout the spring and summer, even temporary roadside drainage ditches often containing them during the spring season of high water, there must be few people in the state who are not at some time exposed to the attacks of the flies. *Simulium* is, in fact, more completely and uniformly distributed in Illinois than *Anopheles,* and as there is no part of the state wholly and permanently free from malarial disease, there would seem to be no part of it free from danger of pellagra, if this is really transmitted by black-flies.

The contrast is marked between these Illinois conditions and those in Italy, where Sambon and his colleagues studied the problem of pellagra and the distribution of the black-fly.

[3] Since printed in a reprint from the 27th Report of the State Entomologist of Illinois, pp. 32 and 42.

There mountain heights, mountain valleys and level plains make up a diversified topography and hydrography, and the distribution of *Simulium* is similarly diversified. It is one of the main lines of Sambon's argument that the distribution of pellagra is limited by the distribution of *Simulium,* although not coextensive with it. This test can not be verified in Illinois, however, as *Simulium* is generally distributed. Pellagra, on the other hand, is intensely local, so far as is now known; but to this interesting point I shall presently return.

The life histories of the American species of *Simulium* are very imperfectly known, and the same may be said of those of all other parts of the world as well. No species, in fact, has been carefully followed, in its development, around the year, and on only two of our American black-flies, *venustum* and *pictipes,* has any kind of definite life-history work hitherto been done. Probably studies of this sort are now in progress in other places than Illinois, but if so their results have not yet been made known. In our own state we have gone far enough with this phase of our problem to make sure that six of our species, and possibly all of them, produce two or more generations in a season, and that there is a sufficient variation among the different species in respect to the times at which the successive generations emerge, to make it certain that some *Simulium* species may be producing adults at every time of any average year, from early April to late October. We have, in fact, ourselves collected adults of one or more species, and have bred others, in each of these seven months, but much more frequently in April, May and June, than in any later ones.

The actual number of individuals on the wing, indeed, diminishes rapidly after the main spring outburst, so that it is usually difficult to find an adult *Simulium* in August or September, even in places made almost uninhabitable by them in April and May. This may be due in part to unknown features of the life history of two of the most prolific species, *pecuarum* and *meridionale,* but it is certainly due also, at least in part, to summer shrinkage of the streams and a consequent reduction in the number of suitable places for the breeding of these discriminating insects. Whatever is the explanation, the fact itself is notorious, and it is of especial interest to our inquiry; for if *Simulium* transmits pellagra, there should be, generally speaking, some seasonal correspondence observable between this highly unequal abundance of the insect carriers of the disease and the number of new cases occurring.

There is, indeed, a very notable seasonal periodicity shown in Illinois in respect to the number of new cases of pellagra, but it is not of the kind anticipated by this reasoning. My attention was first called to the facts last December by Dr. H. Douglas Singer, director of the State Psychopathic Institute, at Kankakee. In the Peoria hospital, where the largest number of our new cases have occurred, statistical data were obtainable from July 1, 1909, to September 1, 1911, and the curve showing the frequency of new cases in this hospital presents five notably high points, each the culmination of a wave of increase, in the period of two years and two months which it represents. In the first of these two waves the twenty-one new cases of July are followed by seventy-one in August, and this maximum by thirty-seven, twenty-three, twelve and three for the months of September, October, November and December, respectively. In January, 1910, there was but one new case; in February and March there were none; in April there was one; and with this a new wave started, reaching thirty-four new cases in June, dropping to but four in July, and rising in a second, lower wave of sixteen and fifteen in August and September, respectively, dropping thence to one in October and none at all until February of the following year.

The largest number of new cases occurring in 1911 was only seven, in August, the next largest number coming in May, when there were six, and the two crests of these waves being separated by the low period of June and July, with one and three cases, respectively. In a word, the two annual high points come in either May or June of two of these years,

and in August of three of them; while in the two years for which our records are virtually complete, the first wave is the highest in 1910, and the second is highest in 1911.

I believed at one time that we might make out a relation of succession between these separate waves of increase and the adult periods of successive generations of *Simulium*, but as my data accumulate this relationship becomes decidedly doubtful; and certainly these double pellagra periods can not be connected with any seasonal differences in the *abundance* of *Simulium*. If there were any causal relation between these two facts there should be but one high pellagra period to correspond with the single spring outrush of *Simulium* adults; or if there were another it should be much lower than the first.

Sambon reports a periodical character different from this observed in Illinois in the fact that it relates to an increased activity of pellagra—an intensification of its symptoms in individual pellagrins—occurring in spring and in fall, coincident, as he says, in Italy with the time of flight of two generations of the sand-flies; and he uses this fact to support his hypothesis of the dependence of the disease on the insects. Assuming that pellagra is produced by a protozoan parasite, he further assumes that the aggravation of symptoms twice each year is due to a migration to the surface of this hypothetical parasite, which is thus exposed to be taken up by the sand-flies as they draw blood from the skin of pellagrins. The summer and fall recrudescences of the disease he thus connects with the summer and fall abundance of the sand-fly imagos. His periods are, however, different from ours, the first coming in March or April instead of May and June, and the second in September or October, instead of August as in Illinois. I have not been able to learn from our physicians that any periodicity similar to this described by Sambon has been noticed in Illinois cases, but if it has it would be impossible to correlate it with the facts above described concerning the development of *Simulium* in our state.

There are other interesting points of contrast between our Illinois conditions and conclusions and those obtained by a study of the problem in Italy and in other parts of Europe. We are told, for example, that in Italy pellagra is a rural disease, to which town-dwellers are virtually immune, even where there is free communication between the town and adjacent pellagrous districts; but in Illinois we have every year several deaths from pellagra in our largest city, with a population of more than two million souls. Four cases of this disease have lately been reported to me from the private practise of Dr. Oliver S. Ormsby, secretary of the State Pellagra Commission, the sufferers from which had lived continuously in Chicago for years. Pellagra, in fact, can scarcely be said to be with us, as yet, a rural disease, the asylums in which ninety-six per cent. of the known new cases have occurred being in or very near cities and towns, and all cases reported from outside such institutions having come from the town and not from the country. The Peoria asylum, containing sixty-three per cent. of our known pellagrins, is in a suburb of our second largest city. It draws its patients from all parts of the state, but more than a third of them come from Chicago or its immediate neighborhood. Three other asylums, containing thirty per cent. more of our pellagrins, receive between sixty-three and one hundred per cent. of their inmates from Chicago. The closest relations of these especially pellagrous asylums thus seem to be with our largest cities and not with our rural districts. These facts would be more certainly significant, however, if pellagra had been longer known and more thoroughly studied throughout our territory, and if we had complete and reliable statistics from the state at large.

Simulium is said in Italy not to live in towns or to enter houses; but in the town of Havana, a village of thirty-six hundred inhabitants situated on the Illinois River near the central part of my state, it is so great a pest in spring that the people screen their windows to protect themselves from the bites of the black-flies; and we have seen these insects collecting there in great numbers on

the inside surfaces of the window-panes of public rooms, such as the offices of hotels. Furthermore, we have found biting species of *Simulium* breeding and emerging in large numbers, not only in the suburbs and outskirts of Chicago, but far within the limits of that great city—in the Chicago River, which traverses the city, passing through its most densely populated districts, and also in drainage ditches beside the streets when these happen to contain streams of running water for a sufficient time in spring. Indeed, it is not too much to say that *Simulium* may breed in any flowing stream within the city where the water is not offensively foul with sewage and other contaminations.

Reasoning from the time of the onset of pellagra in the case of certain infants born in November and in December, when sand-flies are not abroad in Italy, Dr. Sambon comes to the conclusion that the incubation period in these cases could not have exceeded three weeks, this being the interval to elapse between the time when these infants were first carried out in spring to the fields where they might have been bitten, and the date of the appearance of the rash which was the first symptom of the disease. If this reasoning is sound, and these infantile cases are fair examples of the incubation period of pellagra, then I am troubled to explain the occurrence in Illinois of two asylum cases—both reported as first attacks of the disease—one first manifest on the 24th of December, and the other on the 31st of that month, after a period of three or four weeks of severe cold weather. Our latest Illinois collections of *Simulium* adults made in any year were obtained November 5, and these cases consequently seem to have developed some six or seven weeks after any possibility of infection by means of *Simulium* bites. It is possible, however, that this discrepancy is only apparent, and that these were not new cases, arising in the asylum, but recurrent attacks of a disease originating outside and not previously recognized.

Simulium does not require, with us, swift-running streams for its development, some of the species, at least, breeding in any freely flowing water where the surface is broken into a ripple by depending or projecting objects. A stout weed growing from the bottom of a stream near its margin, or a twig bending down and dipping into the water from the shore, or even a trailing grass blade, will in many cases be thickly covered—but only on the up-stream side—with the larvæ first, and afterward with the pupæ, of *Simulium*. We have even found larvæ and pupæ, both in great abundance, coating objects on the bottom of the river at a distance from the shore and at a depth of nine or ten feet—a point in which our observations differ, so far as I know, from any others on record.

In Italy pellagra is said by Sambon to be essentially a disease of mountain valleys, but if this rule applied in America, we should have only imported cases of pellagra in any part of Illinois or, indeed, within hundreds of miles of its borders. There is, in fact, no common topographic feature distinguishing the three principal seats of pellagra in our state. The Peoria asylum, with two hundred and fifty-eight new cases in twenty-six months, is on a bluff about a hundred and fifty feet in height beside one of our largest rivers; the Elgin asylum, with thirty-eight new cases in the same time, is on a more sloping bank, less than half as high, beside a much smaller stream; and the Dunning almshouse is on a level open plain, with no water in its vicinity except a small drainage ditch, which often goes dry in midsummer. The country surrounding all these hospitals is a level or slightly rolling plain, originally covered with prairie grass except where streams were bordered with narrow belts of forest.

From the foregoing it will be seen that, although in this discussion I have been obliged to take a critical attitude towards the *Simulium* theory of this disease, our Illinois data are not, by themselves, conclusive either for or against that hypothesis. This is a source of regret to me, although scarcely a disappointment, as one entomologist, working for so short a time and in so limited an area, could scarcely expect to bring this time-worn

and complicated problem to the point of actual solution; and I must be content with bringing forward my personal contribution of matters of fact to this important inquiry, of a kind to require that they be taken into account in forming an adequate theory of this disease. In the meantime, whether the *Simulium* theory be finally justified or not, it should be especially welcome to us, as I intimated in the beginning, as giving us motive and opportunity greatly to increase our knowledge of these interesting insects; and it is particularly for this reason that I have ventured to bring this imperfect discussion of a problem yet unsolved before this congress of the entomologists of the world.

STEPHEN A. FORBES
UNIVERSITY OF ILLINOIS

EOANTHROPUS DAWSONI

A MEMORABLE and crowded meeting of the Geological Society was held in Burlington House, London, on December 18, to hear a paper read "On the Discovery of a Paleolithic Human Skull and Mandible in a Flint-bearing Gravel overlying the Wealden (Hastings Beds) at Piltdown, Fletching (Sussex)," by Charles Dawson, F.S.A., F.G.S., and Arthur Smith Woodward, LL.D., F.R.S., Sec.G.S.

Four years ago Mr. Dawson noticed that a certain road had been recently mended by peculiar flints, which he traced to a shallow pit. A little later he found that the laborers had dug out a "thing like a coco-nut," the fragments of which they threw on a rubbish heap. Mr. Dawson found there a part of a human skull which he showed to Dr. Smith Woodward; they realized the importance of the discovery, but kept it secret until they had time to exhaust the pit. This took a long time, as it is under water for six months in the year. Half of a mandible was found in the undisturbed gravel close to the spot where the skull occurred.

The gravel at Piltdown rests on a plateau 80 feet above the river Ouse and at a distance of less than a mile to the north of the existing stream. Thus denudation to the extent of 80 feet has taken place since the gravel was formed. In the gravel were found two broken pieces of the molar of a Pliocene type of elephant, a much rolled cusp of a molar of *Mastodon,* besides teeth of *Hippopotamus, Castor* and *Equus,* and a fragment of an antler of *Cervus elaphas;* all of which, like the human skull, were well mineralized with oxide of iron. Many water-worn iron-stained flints were obtained which closely resemble the artifacts from the North Downs near Ightham, to which the term "eoliths" is generally applied. A few implements of the characteristic Chellean type also occurred. The gravel is (archeologically) early paleolithic and (geologically) early pleistocene of about the same age as the Norfolk Forest Bed. Professor Sollas places the Chellean industry in the second genial episode of the Ice Age, but the artifacts of Ightham type, and the remains of elephant and mastodon were doubtless derived from an Upper Pliocene deposit.

Although the cranium is very fragmentary, the pieces recovered so abut on one another that an accurate contour of the brain case can be obtained, and a cast could be made of the cavity, which reveals the broad features of the brain. The cranium is typically human, and has a capacity of at least 1,070 c.c. It measures about 190 mm. in length from the glabella to the inion, and 150 mm. in width at the widest part of the parietal region. The bones are remarkably thick, the average thickness being 10 mm. The forehead is prominent and not receding as in the Neanderthal cranium, and the brow ridge is feeble; the occipital bone shows that the tentorium over the cerebellum is on the level of the external occipital protuberance, as in modern man. The temporal muscles extended higher up on the skull than in any recent or fossil man. When viewed from behind it is seen that the cranium is surprisingly broad and low. The mastoid processes are small. There do not appear to be any characters in the cranium which can not be matched severally in various existing human skulls. No facial bones were discovered. The right half of the mandibular ramus is nearly complete to the symphysis and lacks only the articular condyle and the

upper part of the bone in front of the molars. The horizontal ramus is slender, and resembles in shape that of a young chimpanzee (*Anthropopithecus niger*). The lower symphysial border is produced into a broad flat junction with that of the opposite side, being in this respect completely simian. The ascending ramus is broad, with extensive insertions for the temporal and masseter muscles, and has a very shallow sigmoid notch. Molars 1 and 2 are typically human, though they are somewhat large and narrow; each bears a fifth cusp; their cusps have been worn perfectly flat by mastication. The mandible is certainly the most remarkable feature of the find; although it bears some general resemblance to the Heidelberg jaw, it differs in being less massive, with smaller molars, a still more negative chin, and the simian symphysis. In making a model of the restored jaw Dr. Smith Woodward found he had too much room for the missing teeth and consequently was forced to leave a disastema between the canines and premolars, but on other grounds he believes that the canines were not specially prominent. The jaw as restored is wonderfully like that of a chimpanzee. Thus we have a being with what is virtually a human cranium and a simian jaw. The weakness of the mandible, the slight prominences of the brow-ridges, the small backward extent of the origin of the temporal muscles, and the reduction of the mastoid processes suggest that the specimen belongs to a female individual, and it may be regarded as representing a hitherto unknown species of man for which not only a new species but a new genus must be erected—Dr. Woodward bestowed on it the name of *Eoanthropus Dawsoni*.

Mr. Dawson gave an account of the finding of the specimens, the nature and geographical and geological position of the gravel bed and Dr. Smith Woodward described the remains in a most excellent manner. He pointed out that the skull of *Eoanthropus* was very different from that of *Homo monsteriensis* (*H. neanderthalensis*), and that it bore some resemblance to the skull of a young chimpanzee. He suggested that as the characters of the adult male chimpanzee's skull diverged considerably from the juvenile characters, so possibly *H. monsteriensis* may have diverged from a type like *Eoanthropus*. Professor G. Elliot Smith was called on to give an account of his investigation on the cast of the cranial cavity, and he pointed out that, while the general shape and size of the brain was human, the arrangement of the meningeal arteries was typically simian, as was a deep notch in the occipital region; he regarded it as the most ape-like human brain of which we have any knowledge. Sir Ray Lankester, Professor A. Keith, Professor Boyd Dawkins, Mr. Clement Reid, Dr. Duckworth, Professor Waterston, Mr. Reginald A. Smith and others discussed the paper.

There can be no doubt that this is a discovery of the greatest importance and will give rise to much discussion. It is the nearest approach we have yet reached to a "missing link," for whatever may be the final verdict as to the systemic position of *Pithecanthropus erectus*, probably few will deny that *Eoanthropus Dawsoni* is almost if not quite as much human as simian. The recent discoveries of human remains in the Dordogne region and elsewhere are demonstrating that several races of man lived in paleolithic times, and we may confidently look forward to new finds which will throw fresh light upon the evolution of man.

A. C. Haddon

THE YALE PERUVIAN EXPEDITION OF 1912[1]

On Thursday, December 19, the Yale members of the Peruvian Expedition of 1912 returned to New Haven. This, the third Yale expedition to Peru, was conducted jointly by the University and the National Geographic Society, the Yale members being Professor Hiram Bingham, '98, director; Professor Herbert E. Gregory, '96, geologist; Dr. George F. Eaton, '94, osteologist, and Mr. Osgood Hardy, 1913, assistant—Mr. A. H. Bustead, the chief

[1] From interviews with members printed in the *Yale Alumni Weekly*.

topographer, and Dr. L. T. Nelson, the surgeon, had returned a couple of days previously, having caught an earlier steamer from Panama. Messrs. K. C. Heald and Robert Stephenson, assistant topographers, will return in the course of a week or so. Mr. Joseph Little, assistant, decided to stay in Peru, having secured a position with the Dupont Powder Company. Mr. Paul Bestor, assistant to the director, had been invalided home two months previously, having suffered from a variety of tropical ailments. Mr. Ellwood C. Erdis, archeological engineer, is coming to New Haven *via* the Berlin Museum, where he proposes to spend some time studying the Peruvian collections there before undertaking the work of putting together the various broken pots that were excavated in the department of Cuzco.

Considerable illness, says Professor Bingham in interviews given since his return, overtook this year's expedition and various members were at times incapacitated. The only serious accident happened to Mr. Heald, who escaped death from falling down the face of a precipice only to rupture the ligaments of his collar bone. Nevertheless he carried out important reconnoissance work for a month after the accident but had finally to be ordered back to Cuzco by the surgeon, so that he was unable to penetrate the jungles of the Pampaconas valley as had been hoped.

The map makers, members of the party say, complain that the seasons are changing in Peru. They expected that the "dry season" would give them plenty of time and opportunity for work, but they found, as did the expedition of 1911, that in the great Peruvian Montaña, the jungles on the east slopes of the Andes, the "dry season" is only a relative term, and is much wetter than the "wet season" in some other parts of the world. They were also hindered by finding that valleys which last year had been noted for their salubrity were now the scene of two violent epidemics, smallpox and typhus fever alternating for the mastery. The prevalence of these virulent diseases also interfered with the plans for the anthropological work. Dr. Nelson, who was in charge of the anthropometric measurements, neither dared to leave the engineering party as long as they were exposed to fatal diseases, nor cared to expose the party to the dangers of having Indians from infected houses come to camp to get measured. As practically all the houses in the region were infected, a very serious interference for a period of two or three months was the result. Notwithstanding this, however, the surgeon did succeed in measuring nearly 150 Indians, using blanks prepared by Dr. Ferris of the Yale Medical School. Two photographs were taken of each subject, and also a large number of Indians were photographed who would not submit to being measured.

Professor Gregory's work was confined almost entirely to the vicinity of Cuzco and the Huatanay valley. The complex geological problems here presented occupied nearly his entire time in Peru. Results will be given out in a series of articles to be published as soon as possible. Mrs. Gregory accompanied him, and after the illness of one of the assistants was able in large measure to take his place, especially in the development of important photographs.

Dr. Eaton was unusually fortunate in being able to collect and bring home more than fifty cases of osteological and ethnological material which he collected in the vicinity of Cuzco in the ruins of Choqquequirau and especially in the ruins of the great city of Machu Picchu. In addition to more than fifty skeletons of the Machu Picchu people who were probably Incas or their immediate predecessors, he found a considerable amount of anthropological material in the burial caves. He also collected a number of bones of prehistoric vertebrates, including mastodon, horse and deer. In addition to his osteological and ethnological work, he had general charge of meteorological observations both on the way down and back and at Machu Picchu.

Arrangements were made with Mr. Burt Collins, the director of the Inca Mining Company, and with Mr. Claude Barber, the manager of the Santa Lucia mine, to undertake the care of four meteorological stations for a

period of five years. These stations will be completely equipped with self-recording instruments, and as they are at widely different altitudes the results should prove to be of considerable value.

The chief work undertaken by the expedition was in connection with the study of the ruins of Machu Picchu discovered by Dr. Bingham in 1911. As has already been stated, Dr. Eaton was in charge of the bone hunting and was fortunate enough to find a large number of caves containing skeletons and ethnological material. The clearing of the jungle and the excavating of the ruins was placed in charge of Mr. Erdis, whose four months at Machu Picchu resulted in about sixty cases of potsherds and pots, and two cases of bronze implements. The making of a large scale map of the ruins was entrusted to Mr. Robert Stephenson, who spent three months at a task which it is hoped will result in the construction of a model of this extremely interesting city. The construction of the model will also be assisted by the more than seven hundred pictures which Professor Bingham has taken of the ruins at different times. In addition to the archeological study of Machu Picchu Professor Bingham also devoted himself to exploring four or five sites of ancient ruins hitherto undescribed, and in a systematic effort to discover the ancient place names and to identify localities in the region occupied by the Incas during the last thirty-five years of their reign.

SCIENTIFIC NOTES AND NEWS

The British New Year's honors include the conferring of knighthood on Dr. Francis Darwin, the distinguished botanist; Dr. R. W. Philip, known for his work for the prevention of tuberculosis, and Mr. Stewart Stockman, chief veterinary officer to the Board of Agriculture.

Professor Ehrlich, of Franfort, has received the Bavarian Maximilian order for scientific services.

Dr. Imbeaux, of Nancy, has been elected a corresponding member of the Paris Academy of Sciences in the Section of Agriculture.

A testimonial is planned to Sir Patrick Manson on the occasion of his retirement in recognition of his work in tropical medicine. The testimonial will be national and international. The national testimonial will consist of a portrait and, it is hoped, a scholarship for the advancement of tropical medicine. The international tribute is to be in the form of a gold medallion.

The officers of the Geological Society of America for 1913 are as follows:

President—Eugene A. Smith.

Vice-presidents—James F. Kemp, R. D. Salisbury, C. D. Walcott.

Secretary—Edmund Otis Hovey.

Treasurer—Wm. Bullock Clark.

Editor—J. Stanley Brown.

Librarian—H. P. Cushing.

Councilors—A. H. Purdue, Heinrich Ries, S. W. Beyer, Arthur Keith, Whitman Cross, Willet G. Miller.

Chairman of the Cordilleran Section—J. C. Branner.

Secretary—Geo. D. Louderback.

Councilor—W. S. Tangier Smith.

At the meeting of the Society of American Bacteriologists, held in New York on December 31 and January 1 and 2 the following officers were elected:

President—Professor C.-E. A. Winslow, New York City.

Vice-president—Professor Chas. E. Marshall, Massachusetts Agricultural College, Amherst, Mass.

Secretary-treasurer—Dr. A. Parker Hitchens, Glenolden, Pa.

Council—W. J. MacNeal, L. F. Rettger, D. H. Bergey, H. A. Harding.

Delegate to Council of American Association for the Advancement of Science—Professor S. E. Prescott.

At the recent meeting of the American Anthropological Association held in Cleveland, Ohio, the following officers were elected:

President—Professor Roland B. Dixon, Harvard University.

Secretary—Professor George Grant MacCurdy, Yale University.

Treasurer—Mr. B. T. B. Hyde, New York.

Editor—Mr. F. W. Hodge, Bureau of American Ethnology.

AT the Boston meeting of the American Economic Association Professor David I. Kinley, of the University of Illinois, was elected president for the meeting to be held next year at Minneapolis.

PROFESSOR WILLIAM A. DUNNING, of Columbia University, was elected president of the American Historical Association. The next meeting will be held in Charleston and Columbia, the following meeting at Chicago and a special meeting during the summer of 1915 at San Francisco.

THE Academy of Natural Sciences of Philadelphia has named Dr. Edward J. Nolan, Professor Ulric Dahlgren and H. S. H. The Prince of Monaco as delegates to the Ninth International Congress of Zoology.

LIEUTENANT WILHELM FILCHNER, the German Antarctic explorer, returned with his expedition to Buenos Ayres on January 7 after an absence of fifteen months in the southern seas. He cables from Buenos Ayres that the expedition has been most successful. Lieutenant Filchner purposes continuing his explorations.

DR. WILLIAM CURTIS FARABEE has resigned from Harvard and has accepted a position at the University of Pennsylvania. He will take charge of an expedition to South America, the primary object of which is ethnological study, although scientific men in other departments will accompany the expedition. A steam yacht has been provided and equipped for the comfort and safety of the members of the expedition and for the prosecution of the scientific inquiries for which it is organized. Investigations will be conducted along the Amazon and its tributaries and in the northern part of South America. Provision has been made to keep the expedition in the field for three years.

PROFESSOR ROLLIN D. SALISBURY, head of the department of geography and dean of the Ogden School of Science of the Chicago University, has returned from South America, where he had been investigating the glacial formations of Argentina and Patagonia.

MR. CLINTON DEWITT SMITH is about to return to this country from Brazil. He organized and became president, five years ago, of the first agricultural college in Brazil, intended as a model for other colleges. Professor Smith was for fifteen years director of the Experiment Station of the Michigan Agricultural College.

PROFESSOR M. M. METCALF, head of the department of zoology at Oberlin College, has been granted leave of absence for travel and study during the second semester.

AT the annual meeting of the Washington Academy of Sciences, on January 15, Dr. Frederick V. Coville gave the address of the retiring president on the formation of leaf mould.

THE sixth Harvey Society lecture will be given on January 18 at the New York Academy of Medicine by Major Russell, of the United States Army, on "The Prevention of Typhoid."

THE Minnesota local section of the American Chemical Society had recently a special lecture on "The Electron Theory," by Professor W. A. Noyes, director of the chemical laboratories of the University of Illinois.

DR. L. O. HOWARD, chief entomologist of the U. S. Bureau of Entomology, lectured before the undergraduates of Oberlin College on January 7, speaking on certain types of noxious and beneficial insect life. Professor Winterton C. Curtis, of the University of Missouri, lectured there on January 8 on "The Social Value of Abstract Research."

IT has been proposed to the municipal authorities of Paris that the memory of Henri Poincaré should be honored where he taught, and it is suggested that the portion of the Rue Vaugirard between the Boulevard St. Michel and the Odéon should be named after him.

A CELEBRATION of the centenary of the birth of James Dwight Dana (1813–1895) was held at Yale University on December 29, in connection with the annual meeting of the Geological Society of America. President Hadley presided and referred in his introductory remarks to Dana's pioneer work in zoology and

geology. Professor William North Rice, of Wesleyan University, read a paper on "Dana the Man"; Dr. E. Otis Hovey, secretary of the Geological Society and curator of geology at the American Museum of Natural History in New York City, spoke on "Dana the Teacher"; Dr. George P. Merrill, head curator of geology of the United States National Museum at Washington, spoke on "Dana the Geologist," and President Fairchild, of the Yale Alumni Association, read the paper on "Dana as a Zoologist," written for the centenary by John Mason Clarke, director of the Science Division of the Department of Education of New York State. Books, pamphlets, monographs, greetings from learned societies and personal memorabilia were exhibited in Chittenden Library during the week.

Mr. Thomas Howell, the well-known Oregon botanist, died on December 3, 1912. He was born in Missouri on October 9, 1842, and was a pioneer of Oregon, moving there in 1850. Although he had very scanty schooling, Mr. Howell was far from being an uneducated man. He devoted many years of his life to the study of the flora of Oregon, tramping over nearly every portion of the state. His knowledge of the northwestern flora is embodied in the work entitled "The Flora of Northwestern America." Perhaps the most noteworthy discovery of Mr. Howell was the finding of *Picea Breweriana,* a very local tree and the last of the Pacific Coast conifers to be discovered.

Dr. Peter Redfern, formerly regius professor of anatomy and physiology in Queen's College, Belfast, died on December 22, at the age of ninety-one years.

Dr. A. Pfarr, professor of hydraulics in the Technical School at Darmstadt, has died at the age of sixty-one years.

The papers on the program for the Cleveland convocation week meeting were distributed among the sciences as follows:

Mathematics	49
Astronomy	35
Physics	52
Engineering	40
Geology	27
Zoology	84
Entomology	73
Botany	60
Phytopathology	49
Horticulture	53
Anthropology	27
Psychology	56
Biological chemistry and pharmacology	63
Anatomy	63
Physiology	67
Education	11
Economics and Sociology	13
	822

The department of superindence of the National Educational Association will meet at Philadelphia from February 24 to March 1. With it meets the National Council of Education, the Department of Normal Schools, the National Society for the Study of Education and a number of other educational societies.

President Taft in a special message to congress, on January 8, recommended the repeal of the act of congress which prohibited for five years the killing of fur seals on the Pribilof Islands, passed a year ago. Investigation, the president said, showed a remarkable increase in the size of the herd in one season and proved conclusively that only the female seals and the bull male seals need protection, and that thousands of "bachelor" seals can be killed each year without reducing the herd. The act which should be repealed was adopted to give effect to the first seal treaty of 1911 between Great Britain, Japan, Russia and the United States. Although a clause in that treaty, the president points out, seems to give the United States authority to suspend land killing to protect and preserve the herd, if no actual necessity were found for such suspension it was not justified under the convention and the act should be amended.

The board of managers of the Marine Biological Association's laboratory at Plymouth, England, has recently decided upon a policy of emphasizing the purely scientific and international character of the institution, thus rendering it more readily accessible to American students than it has been in the past. In its equipment it is second only to Naples, being well supplied with apparatus and chemicals required for advanced research, and provided with a steamer of 69 tons burden. An effi-

cient staff of attendants is maintained and every effort is made to meet the special requirements of those who occupy tables, especially when the work is of a physiological or chemical character. Many important papers have emanated from the laboratory during the past three years, and the new policy inaugurated by the board of managers may be expected to render the laboratory the "Naples of the North," and advanced students who contemplate the prosecution of researches upon the marine fauna of northern Europe may advantageously write to the director of the Plymouth Laboratory, Citadel Hill, Plymouth, England, for specific information.

MR. NELS C. NELSON, assistant curator in anthropology at the American Museum of Natural History, has returned from an archeological expedition to the southwest. A systematic search for archeological sites was begun at Ysleta del Sur, a few miles below El Paso, and completed northward to the latitude of Santa Fé. Within this section of the drainage 115 sites of more or less interest were located and about half of these were inspected. Actual excavations were conducted in two localities. First a group of seven large Tanos pueblo ruins, located on the border of the Galisteo Basin twenty-five miles south of Santa Fé, were worked to the extent of determining their age and culture relations; and later one entire Keresan pueblo ruin, located on the Jemez National Forest seven miles northwest of Cochiti, was cleared. Besides digging trial trenches and examining refuse heaps, four kivas and 573 ground-floor rooms were cleared. The débris removed from these rooms ranged in depth from two to twelve feet and represented, with few exceptions, two and three story houses. The resulting collections comprise sixty more or less complete human skeletons and about two thousand artifacts.

DURING the week of January 6 a "Mental Hygiene Exhibit and Conference" was held at Yale University under the joint auspices of the National Committee for Mental Hygiene and the Connecticut Society for Mental Hygiene, assisted by representatives of Yale University. The public exhibition of the work of the National Committee for Mental Hygiene will later be given in Chicago, Princeton, Baltimore, Boston, and Philadelphia, and is designed to give tangible evidences of the need of public information as to the causes, treatment and prevention of mental disorders. It has already been shown in Washington and New York. Speakers announced to make addresses during the week were: Dr. Henry Smith Williams, of New York City; Dr. Stewart Paton, of Princeton; Dr. George Blumer, dean of the Yale Medical School; Dr. August Hoch, director of the Psychiatric Institute of the New York State Hospitals on Ward's Island, New York City; Dr. George H. Kirby, clinical director, Manhattan State Hospital, New York City; Dr. C. Macfie Campbell, of the Bloomingdale Hospital, New York; Professor William H. Burnham, of Clark University; Dr. Thomas W. Sallmon, New York, and Dr. S. E. Jeliffe, of Fordham College.

THE United States will be the meeting place of the Fourth International Congress on School Hygiene. The preceding congresses have all been held abroad, the first at Nuremberg in 1904, the second at London, 1907, and the third at Paris, 1910. The 1913 congress will be held at Buffalo, N. Y., August 25–30. It is the object of the congress to bring together men and women interested in the health of school children and to assemble a scientific exhibit representative of the most notable achievements in school hygiene. It is believed that the present wide-spread public interest in health education will make the exhibit a particularly attractive feature of the congress. Twenty-five nations have membership on the permanent international committee of the congress and it is expected that all will have delegates at Buffalo. The Secretary of State has officially invited foreign governments to participate. Invitations have also been issued to the various state and municipal authorities, and to educational, scientific, medical and hygienic institutions and organizations. The president of the congress will be Charles W. Eliot, president emeritus of Har-

vard University; the vice-presidents, Dr. William H. Welch, of Johns Hopkins, and Dr. Henry P. Walcott, of the Massachusetts Board of Health. The long list of honorary vice-presidents includes: Dr. Abraham Jacobi, of New York City; Dr. William H. Burnham, of Clark University; Cardinal Gibbons; Dr. P. P. Claxton, United States Commissioner of Education; Surgeon-General Blue, of the Public Health Service; Dr. H. M. Bracken, of the Minnesota State Board of Health; President David Starr Jordan, of Leland Stanford Junior University; Dr. Woods Hutchinson, representing the National Education Association, and many other distinguished physicians, educators and civic experts.

UNIVERSITY AND EDUCATIONAL NEWS

Mr. John R. Strong has given to the New York State College of Forestry at Syracuse University for use as a forest experiment station 100 acres of forest land at Tannersville in the Catskills, including a summer residence. The tract will be used as a forest experiment station and for a students' camp in the summer.

Williams College has received $20,000 from the estate of John Savary, '55, of Washington, D. C. The income from this amount is to be used for the purchase of books for the library.

Western Reserve University has received from Mr. Henry F. Lyman, of Cleveland, a large collection of shells, corals and agates. The collection is one begun by Mr. Lyman during a visit to the Hawaiian Islands in 1875.

Science Hall of Ohio University, Athens, Ohio, has been completed and is now occupied by the three departments of physics, chemistry and biology. The building is a four story structure of red pressed brick, 79 feet by 124 feet, costing about $120,000. The department of physics and electrical engineering occupies the first two floors. These will provide recitation rooms and offices for the instructors in the department; a large laboratory for general physics, with two dark rooms and apparatus rooms attached; laboratories for the various advanced courses in physics, with the necessary weighing rooms and apparatus rooms; a laboratory for electrical measurements, with apparatus rooms and weighing rooms attached; a dynamo motor and transformer laboratory; a photometric laboratory; a storage battery room; high temperature laboratory; unpacking room; storage rooms; several small research laboratories; constant temperature laboratory; drafting room; shop; private laboratory; library and reading room. The other departments are correspondingly arranged.

A course in general science leading to the degree of bachelor of science is offered for 1913–14 in the College of Arts and Sciences of the University of Vermont. This course is similar to the A.B. and Ph.B. courses in its adherence to the group system, but differs from them in requiring mathematics and physics and a larger amount of work in the scientific group of studies. The course is intended for those who intend to teach the sciences in secondary schools and for those who desire a broad scientific training before entering a technical or professional school. The entrance requirements of the new course lay stress on the sciences rather than on the languages.

The Massachusetts Institute of Technology will hold a reunion of alumni in New York City on January 17 and 18. There will be special trains from Boston and probably from Washington and Philadelphia. The plans include class luncheons on Friday and a mass meeting in the afternoon; society and fraternity breakfasts on Saturday, departmental luncheons and a banquet in the evening. At the mass meeting on Friday afternoon the following have accepted the invitation to speak: President R. C. Maclaurin, Mr. John R. Freeman, Professor D. R. Dewey, Professor A. A. Noyes and Professor W. T. Sedgwick. Speakers at the department luncheons will include the following:

Course I.—Professor C. M. Spofford, Professor G. F. Swain.

Course II.—Professor E. F. Miller, Professor G. Lanza, Dean Goss, of the University of Illinois.

Courses III. and XII.—Professor R. H. Richards and Professor W. Lindgren.

Course IV.—Professor F. W. Chandler and Professor J. Knox Taylor.

Courses V. and X.—Professor H. P. Talbot and Professor W. H. Walker.

Course VI.—Professor D. C. Jackson, Professor Elihu Thomson, Mr. Gano Dunn.

Courses VII. and XI.—Professor W. T. Sedgwick and Mr. Rudolph Hering.

Courses VIII. and XIV.—Professor C. R. Cross and Professor H. M. Goodwin.

Course IX.—Professor D. R. Dewey and Professor H. G. Pearson.

Course XIII.—Professor C. H. Peabody.

At the banquet on Saturday night President Maclaurin, President A. C. Humphreys, of the Stevens Institute of Technology, and Mr. John V. Bouvier will be among the speakers.

DISCUSSION AND CORRESPONDENCE

A NATIONAL UNIVERSITY AT WASHINGTON

THROUGH the courtesy of President Charles R. Van Hise, of the University of Wisconsin, the writer is just in receipt of a reprint from SCIENCE, of August 16, 1912, entitled "A National University, a National Asset; an Instrumentality for Advanced Research," the same being an address delivered by him at the 1912 meeting of the National Education Association.

The paper is a clear, comprehensive and practical exposition of the desirability and possibility of the fullest practicable systematic utilization, by those having the bachelor's degree with a year's subsequent practical work, of the extraordinary research facilities at Washington, embracing physical science and sociology (the latter including anthropology, political economy, political science and history), with such lectures by government officials as will direct the work to the highest efficiency. As such, the paper is a valuable contribution to the subjects involved, and is so excellent, as far as it goes, that the writer is reluctant to say aught in criticism, and does so only because the cause of education seems to require it.

The paper is not more noteworthy for what it advocates than for what it might be expected to advocate. Its negations are quite as marked as its affirmations. The first paragraph is as follows:

> At the outset, the guiding principle may be laid down that at Washington there is no necessity for a university of a type which exists elsewhere, no need of an additional university like the great endowed and state universities of the country. One who advocates a national university at Washington with the idea that it shall be a larger Harvard, Yale, Columbia, Cornell or Chicago, a larger Michigan, Illinois, Wisconsin, Minnesota or California, will fail in his advocacy, because he can not give to Congress a sufficient reason for the expenditure of public funds for another university of a kind of which there is a sufficient number. Not only would such an advocate be met by the above fact, but by the fact that in Germany, where universities are most highly developed, they are state, not national institutions.

In the first place, the statement with respect to Congress is opinion only. In the writer's judgment, sufficient reasons *have* repeatedly been given to Congress, and if Congress has not been appreciative enough of the higher education, the fault has been not with the reasons, but with Congress. The mere fact that Congress has heretofore disregarded the proposals of the most distinguished committee ever constituted in an educational interest (although having a Senate standing committee on the University of the United States which in recent years has made four favorable reports, all but the third unanimous) is no reason for not continuing the campaign until Congress either recognizes the merits of the case or capitulates in the spirit of the unjust judge of Biblical parable.

As for Germany, it needs but be said that, if she has not yet attained the national university conception, she is on the way to it, and the German mind can be trusted to work out the problem of university education to its logical result.

And so the question reverts to the "guiding principle" of the paper. If the writer be not mistaken, there were Wisconsin colleges, excellent for their day, already existing when the

University of Wisconsin was inaugurated. What need, or "necessity," to use the word in the paper, was there for the institution over which President Van Hise is proud to preside? If Michigan, Indiana, Illinois, Iowa and Minnesota had state universities, and Wisconsin had none, would he not, as a resident of Wisconsin and an educator, not only advocate a state university for Wisconsin, but also wish it made as broad and strong as possible—if practicable, "larger" than the others? Indeed, would he deprecate the establishment of a first-class state university wherever there is none to-day? It is not likely. Then why discriminate against the District of Columbia, the nation's ground, and deny it the high privilege of an institution of the "university type," commensurate with the ideals, needs and resources of the nation?

He has faith in the "university type" of education in the states. He considers it there a very valuable and noble agency. But when he enters the District of Columbia his faith leaves him. What is the matter? Is not the nation but a larger state? Is the genius of the nation unsuited to the conduct of the fullest instrumentalities of education? Is the national atmosphere unsuited to that form of institution, the "university type," which both the reason and the experience of mankind in all ages have proven the most fit for the development of the higher learning, and which has served its purpose elsewhere so admirably? Apparently so. For, when he leaves Madison as an educator, he arrives at Washington chiefly as a scientist. What has transformed —contracted him? Has the spirit of the broadest learning, fostered in his northern home, become enervated by his removal to a more southern clime? Has the materialistic and commercial spirit of the age, which he withstood so nobly in Wisconsin, gained the ascendancy on the banks of the Potomac? Has he lost that priceless gift of the mind—vision? Whatever be the reason, his educational view has narrowed, and in the capital of his country, where, if anywhere, it might be expected to be comprehensive, it is principally limited to the sciences. Swedenborg, to be sure, saw that science, with all its uses, is but the husk of knowledge. But Swedenborg would be laughed out of a modern court of science. Science (unfortunately) has little use for seers. And so, for some unexplained reason, it is illegitimate, or unwise, or unsafe, or inappropriate, or impracticable, to do at Washington, in the name and with the support of the nation, what it is eminently legitimate, and wise, and safe, and appropriate, and practicable to do, to a less extent, at Madison, for instance, in the name and with the support of the state of Wisconsin.

Is President Van Hise any more a citizen of Wisconsin than a citizen of the United States? Does his ambition for American education halt at state lines? Would he have pride in no institution of the "university type" beyond the state and privately endowed universities? Are not these institutions, however great and strong, constantly seeking enlargement, and likely to continue to do so indefinitely? And yet do not they themselves recognize the significant fact that, with every increase of knowledge, the domain of the unknown, so far from decreasing, only expands to the view? If the first love of these institutions be for learning, why should not they welcome any new institution of the "university type," whether less or "larger" than themselves, calculated to assist in the search for truth—and welcome it the more in proportion to its power and importance? Is it possible that they imagine themselves, with their ever necessary limitations, the only institutions of the "university type" needed for the exploration of the boundless fields of knowledge? Can he be satisfied with them, or they with themselves, when a greater institution of the "university type" than any of them can ever hope to become may be created by the nation as a co-worker and helpmeet in the domain of universal learning? Can institutions of the "university type" be too numerous, or any one of them too "large" to realize the sublime conception of Johann Kepler, "the legislator of the heavens," when he exclaimed: "O God, I think thy thoughts after Thee!"? Will President Van Hise

mention a single argument, valid for a state university, that will not be at least equally valid for a national institution of the "university type"?

The state and privately endowed universities have done a noble educational work, and are contributing much to the advancement of American civilization. And it is no fault of theirs that they can not perform a nation's educational service. It is no disparagement of them that a national institution of the "university type" can do what they, either individually or collectively, will never be able to accomplish. It is the function of nationality to effect more than what is possible to lesser entities, and in no field of service can the national power confer a more signal benefit upon humanity than in the cultivation of the highest and broadest learning. In so far as a nation fails in this regard, it is especially recreant to its trust. And the educator can do his country no finer service than in persuading the nation to be true to itself by providing, in its own great name, the fullest instrumentalities for the pursuit of knowledge universal. Nor can these agencies be furnished in any form so well as by the establishment at the national capital of an institution of the time-tested "university type"—an institution analogous to the eloquent Charles Sumner's "grand temple of universal peace, whose dome shall be as lofty as the firmament of heaven, as broad and comprehensive as the earth itself"—such a university as was in the prophetic vision of the writer's recently deceased father, Ex-Governor John W. Hoyt, for the last nineteen years of his life chairman of the National Committee of Four Hundred to promote the establishment of the University of the United States, when he wrote:

> a broad and noble institution, where the love of all knowledge, and of knowledge as knowledge, shall be fostered and developed; where all the departments of learning shall be equally honored, and the relations of each to every other shall be understood and taught; where the students devoted to each and all branches of learning, whether science, language, literature or philosophy, or to any combinations of these constituting the numerous professional courses of instruction, shall intermingle and enjoy friendly relations as peers of the same realm; where the professors, chosen as in France and Germany, after trial, from among the ablest and best scholars of the world, possessed of absolute freedom of conscience and of speech, and honored and rewarded more nearly in proportion to merit, shall be, not teachers of the known merely, but also earnest searchers after the unknown, and capable, by their own genius, enthusiasm and moral power, of infusing their own lofty ambition into the minds of all who may wait upon their instruction; a university not barely complying with the demands of the age, but one that shall create, develop and satisfy new and unheard of demands and aspirations; that shall have power to fashion the nation and mold the age unto its own grander ideal, and which, through every change and every real advance of the world, shall still be at the front, driving back from their fastnesses the powers of darkness, opening up new continents of truth to the grand army of progress, and so leading the nation forward and helping to elevate the whole human race.

But President Van Hise apparently does not wish any such institution as that. He would have the state or privately endowed universities—necessarily the less competent agencies—attempt the broader educational labors, and leave the narrower work to the nation—inherently the more capable instrumentality. The greater field is too high and "large" for the nation. Some of the organic constituents of the nation, with other scattered agencies, can perform the national educational function better than can the nation itself. With all respect to the distinguished gentleman, the writer is impelled to ask, Could provincialism go further? His university attitude at Washington is what might be anticipated of a scientist, but is it what would be expected of an educator?

And so, why should *not* the nation establish, maintain and develop, in its name and at its capital, an institution of the "university type," calculated to become eventually the leading university of the world? The essential reason for such an institution, as has been shown, is, not that it may be "larger" than some other, but that, it being supported by the nation, the cause of learning and of truth will

be more fully served than will otherwise be possible. And this reason is not only legitimate. It is controlling. The claims of these high interests are paramount, and no lesser institutions or interests can properly be allowed intervention at the bar of American education.

A word on a subsidiary matter—degrees. The paper would deny to the national institution it advocates the power to confer them. Now, the writer assumes that President Van Hise desires for his proposed institution every agency that will contribute to its attractive force and its standing in the learned world. But will he say that degrees will not contribute powerfully to these important ends? Have not degrees in all ages been proven stimulants to study, certificates of attainments, and passports to practical opportunities in after life? Would not an institution lacking authorization to confer them be necessarily handicapped and lowered in the estimation of other institutions and hence its usefulness and honor be diminished? He of course appreciates the value of degrees both to students and to institutions, but he would confine them to the state and privately endowed universities. He says:

> After a student has continued his work at Washington to the point where he would have a doctorate, he may take his examination and qualify himself for his doctorate at the institution at which he previously studied, and thus add to the prestige of that institution. Naturally, a part of such qualification would be a thesis prepared by using the material in the bureaus and departments.

A remarkable proposal—quite as surprising an anomaly as the paper's "guiding principle"! What would President Van Hise say if a student, after completing an undergraduate course at the University of Michigan, for instance, should take a graduate course at the University of Wisconsin, and then return to the University of Michigan for his examination, thesis and doctorate? Is it too much to say that the president of the University of Wisconsin would make a vigorous protest? And rightly. The laborer is worthy of his hire. Honor to whom honor is due. Fortunately, the spirit of equity among American universities would not permit such an infringement of university rights. But what he would resent for his state he proposes for the nation. He would give his state her dues, but in the case of the nation he would add insult to injury and put it off with a defrauded as well as a fragmentary institution. How will the spirit of equity among our institutions of learning meet such a real proposal as this?

Would a degree lose its value because conferred by a national institution? Indeed, would not its value be thereby indefinitely enhanced? And at the same time, would not the very fact that other institutions of the country were made the necessary gateways to the national institution operate to augment and strengthen those other institutions? If degrees are desirable for the University of Wisconsin or for Harvard, by what process of reasoning are they found undesirable for the national institution proposed in the paper? Is there more concern for the prestige of the state and privately endowed universities than for the prestige of the national institution?

Had the paper not laid stress on the "prestige" of the state and privately endowed universities of the country, the writer would say no more on that subject, for the word, as used, involves more than one unacquainted with the history of the national university movement would imagine. "Prestige," and its offspring, pride! There is pride, and there is pride, and they differ as darkness from light. There is pride which concerns individuals, as such, and which is loath to see any "larger" excellence than that rendered possible by its own circumstances. And there is pride with an eye single to the content of that which another is better circumstanced to accomplish, and individuals, as such, are forgotten in the greater good. Which form of pride shall characterize American education?

The paper is candid enough to admit that such an institution as it advocates would not properly be called a "university" at all. It says:

> If there be prejudice against calling the institution above described a national university, it

may be given some other name, since as a matter of fact the institution proposed would be different from any existing university in that it would not profess to give a complete system of courses regarding any subject, but would give such specialized courses as the facilities at Washington made advantageous; and also it differs from a university in the respect that it would not grant degrees.

The university title for such an institution would indeed be a misnomer and hence misleading and indefensible. The present writer, as is evident, has in view for his country a true national university. By the term "university," undergraduate as well as graduate work is generally understood, inasmuch as most of the work done in institutions bearing that title always has been, is, and ever will be undergraduate. As a matter of fact, however, the national university advocacy, almost from Washington's day to this, has been for an institution that would not be a rival to any others—for an exclusively graduate university—an institution that shall stimulate, elevate, standardize, coordinate and supplement American public education, utilize the government facilities, conduct government researches and investigate the unknown; inspire ambition for the highest learning, maintain cooperative relations with other institutions and increase their patronage by making its honors the goal of their graduates; foster nationalism, provide the educational facilities which Americans seek abroad, and, by attracting foreign students, diffuse democratic ideas—an institution that will, to an extent possible to none other, whether one or all, advance the cause of learning and give the United States a new and supreme dignity and influence.

The people of the District of Columbia are, indeed, entitled to an undergraduate as well as graduate institution of learning, and one of the former grade could be affiliated with the latter. But the District is a very small fraction of the United States. The supreme need is for learning and for the nation, for the highest and broadest institution possible of the "university type" at Washington—a need to be measured both by what the institution can do for learning and for the nation, and by what the nation can do for the institution—a need which, so far from decreasing with the growth of other institutions, increases with the years, as the nation becomes greater and as the infinity of truth is ever more fully realized.

There are offences of omission as well as of commission. It is bad enough to offend at all against one's country. But the paper under consideration, in presuming to set bounds to educational opportunities under the national name and auspices, and in the fullest and most fruitful form yet evolved—an institution of the "university type"—commits a yet graver offence—an offence against learning. No man and no set of men can afford even half-disloyalty to that sacred cause. The instrumentalities for the pursuit of knowledge may be circumscribed only to the ultimate disappointment of those audacious enough to attempt the curtailment of its beneficence. The temple of universal learning has no forbidden shrines or prohibited forms of worship, whether for an individual, a state, or a nation, and they who would pronounce any interdict there must reckon with the everlasting law of progress.

(Since the above was written, the writer has received a letter from President Van Hise, in answer to one remonstrating against the apparent lacks in the SCIENCE paper. President Van Hise says:

> In response to your letter regarding a national university, I have to say that I advocated the ideas presented in my paper with the belief that the steps there suggested should be the first ones. As a matter of practical expediency, it seems to me to be wise at the present time only to push for those ideas regarding a national university of which there is some chance of acceptance. If the steps I advocate were made at first, it is my conviction that the future would take care of itself. With a national university once founded, its growth would take place wherever sooner or later it appeared such growth would be advantageous to the nation.

If President Van Hise intends the institution he advocates as the beginning of a real national university, the author is gratified, but the paper gives no hint of such intention, with

respect either to its scope or its degree-conferring power—its constitution, in a word, as an institution of the "university type"—and, while it may be necessary to begin as he suggests, the writer deems it important to keep the ideal before the country, and so lets the paper stand as written.)

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NEO-VITALISM AND THE LOGIC OF SCIENCE

TO THE EDITOR OF SCIENCE: In the discussion to which you have recently given space concerning the availability for science of the system of implications to which vitalism and the conception of entelechies lead, it is important to refresh one's memory concerning the general methodological postulates of science, for in the final analysis every special argument in such a case is nothing but the assertion of a specific point of view in regard to the system of conceptions with which science works in reducing the world of phenomena to order.

The conception of intelligible order is the product of a slow intellectual development which is reenacted by every human society in its progress toward civilization and by every child in its growth toward mental adulthood. Between the theoretical limits of a world of anomy and the assumption of necessary law the evolution of this concept presents an infinite series of modifications. The universal presence of law is the underlying assumption on which all investigation proceeds, and the advancement of science is measured by the field which it has redeemed from chaos and conceived in terms of intelligible order. But in certain of its relations this conception is scarcely more than a theoretical postulate which expresses a logical conviction as to the nature of the world and inspires the persistent search after new laws. It expresses the belief, in regard to each unreduced phenomenon, that the logical canons which have guided investigation to a triumphant conclusion in other fields must ultimately be found valid here also.

As to the phenomenal basis of such conceptions common observation sufficiently establishes the fact of recurrence, both of elements and complexes. Familiarity with these connections of experiences, however, does not carry the mind inevitably toward their uniformity. Man's first uncritical reflection leads only to the general expectation of recurrence. Failures and fulfilment must equally be accepted as facts. In one field order prevails, in another, caprice. It is an empirical inference which no more assumes necessary connection as its reflective postulate in the one case than it does anomy in the other. But the human mind is not content to rest at this stage. The world of phenomena is not a pure object of contemplation. It is endowed with energy and penetrated with living potencies and purposes, conceived in terms of agents and active causes. These spiritual powers in whom change is grounded are unique as well as individual, and each is marked by a characteristic activity. The world must be taken as it is found; if unpredictable as well as dependable successions occur, the causes to which they are referred must correspondingly vary. Arbitrary and capricious wills appear on the theater of events along with those which are consistent and inalterable. Wonder and miracle lie embedded in the world's structure alongside of established and predictable order.

The habit of thus conceiving phenomena in terms of disparate principles dies hard. It yields only before the slow extension of law as the investigations of science are pushed farther and farther and one range of phenomena after another is brought under control. At first it is not perceived by the scientist himself that the postulate of universal and necessary law underlies all his procedure, that the conception of uniformity is not confirmed by the slow accumulation of evidence but constitutes the basis of every conclusion he draws. The principle of all scientific method is established only when this relation is first clearly apprehended. As the connections of phenomena are more widely discerned the region of anomy undergoes progressive limitation and the world of miracle gives

place to a universe of law. Order replaces disorder, necessity supplants chance in the thoughts of men, until the realm of experience is finally viewed as a consistent and rational whole, wherein every change is conditioned by uniform antecedents and expressible in terms of natural law.

The application of this point of view, it may logically be said, implies a preliminary treatment in which phenomena are organized in a unitary system of classifications on the basis of specific resemblances and differences. But the process of defining and naming, of conceiving individuals in terms of fixed characteristics and referring each to its place in a logical scheme may be said merely to provide the data for the mind's final operation whose field is the interaction of things. The world is treated dynamically as well as statically. The subject of specific characteristics is also the origin of certain effects. It has its place in a causal series as well as in a classificatory system. The logical relations of likeness and difference must be supplemented by the empirical relations of genesis and historical origin. To connect events in this way is to explain them. The world as a system of objects can only be described; to be explained it must be conceived as a system of orderly successions in time. The universal principle of explanatory science is thus to be found in what is termed the conception of causal relation, since it is simply the generalization of this idea of uniformity in historical succession. Natural science therefore rests finally upon the assumption of mechanism and excludes all other conceptions.

Historically the explanations of science have been supplemented at every stage by principles dependent upon the assumption of purpose or function, but every such recourse represents a failure in the scientific undertaking or a loss of the scientist's vision. Its interpolation indicates either the presence of an unresolved problem or a confusion as to the nature of scientific explanation. The ideal of science is, from the methodological point of view, perfectly clear; it is to determine the atomic constitution of the world and to formulate the mechanics of its changes. The particular constitution of the units and formulas with which the scientist works may vary from age to age, since these are necessarily provisional and relative to the level of analysis attained at any given time; but the formal ideal of all analysis is unaffected by such changes and remains theoretically constant. The unit must be simple, the formula universal. No ultimate difference among the constitutive units, and no partition of the world between irreducible forms of change can be admitted. This is the fundamental assumption from which the scientist can not allow himself to be swerved by any complication of the phenomena to be treated or any difficulty in their resolution.

Such a postulate can be maintained only in view of the fact that science is not an attempt to exhaust the account of reality, and that its presuppositions constitute but a necessary methodological delimitation. Reality is viewed by man in a series of differing relations, each of which involves a specific set of such presuppositions. With none of these other points of view, however, can science have even contact; and the penetration of his own field by the conceptions to which they give rise can mean only the disorganization of his results.

The traditional form in which this adulteration of scientific method has been manifested is an employment of the conception of creative spirits, essences and powers as explanatory formulæ. Angels and demons, entelechies and souls, function and purpose, force and will; vitalistic, morbific and soporific agencies have been invoked in turn as explanatory hypotheses. It may be that human reflection has need of this whole class of conceptions in its complete review of reality; but in the special work which science in general undertakes they can afford no help whatever. Each relapse into such modes of thought marks the point at which scientific analysis has stopped and amounts to nothing more than the confused recognition of an irreducible element in experience. This the scientist must recognize as well as any other, but it is absurd to make

of it a constitutive or explanatory principle. It affords no means of analysis; it determines no specific change; it contributes no formula of relation. At whatever level it appears this conception stands only for the unresolved residuum by which reflection is faced.

Thus in the study of organic life it may be that the biologist is unable to state the facts of development in terms of the known chemistry of the cells, or of the local relation of parts in the segmented ovum and their polarities and bilateralities, or of the influence of external agents upon the organisms; but it is nevertheless inadmissible to formulate the problem in terms of a conception which falls without this whole system of principles and to say that, since the chemical and mechanical conceptions which we are now able to apply to organic development have proved inadequate to the statement of that process in its entirety, we must conceive it as autonomous and treat it in terms of entelechies. Autonomousness is a conception which falls without the domain of science altogether, because it applies to the thing only in its self-dependent totality—with which philosophy deals—and not to the thing in its relations to other things, as science must conceive it. Only in terms of their interaction can the empirical reason explain things at all; and in the case of organic development, as of all other processes, explanation must be through the determination of specific causal relations.

This mechanistic conception of science is of course a purely methodological assumption into which no ontological meaning is to be read. Its nature is misunderstood when, for example, it is called materialistic. The mechanistic conception applies to all facts which fall within the domain of science, whatever the metaphysical interpretation which may be given to them.

Robert MacDougall

New York University,
October 14, 1912

A PROTEST

To the Editor of Science: Permit me to offer an emphatic protest against the closing paragraph of Dr. Dorsey's letter in this week's Science (December 6). It is Dr. Dorsey's right, if conscience and judgment impel him, to express disapproval of missionaries in respect to either their purpose or methods or both, but to accuse them of "distortions," made from mercenary motives, is an utterly unjustifiable bit of spite. It not only reveals lamentable ignorance of facts, but betrays that intolerant and biased attitude of mind against which scientific men are supposed to particularly guard, and which in my judgment vitiates Dr. Dorsey's whole argument.

Hubert Lyman Clark

QUOTATIONS

THE EFFICIENCY NOSTRUM AT HARVARD

There has been a great deal of groping in the dark over the problem of raising the quality of our universities and colleges. But light has appeared at last. There will no longer be any futile casting about for improvements here and changes there, no more mere scratching of the surface. Somebody at Harvard has gone straight to the heart of the matter. Indeed, he has solved the whole problem in point of principle, though of course the details of the beneficent revolution he has started remain to be worked out. What has been needed all along has been some simple and yet profound guiding principle, and this is what the new move at Harvard supplies. See that you get your money's worth out of each professor—this is the philosopher's stone, which, firmly and steadily applied, is going to transmute into gold all the baser metal of our university faculties.

Seldom has a great reform been ushered in so noiselessly. "Harvard professors and instuctors," so goes a newspaper account, "are thoughtfully rubbing troubled brows to-day while they ponder over an intricate network of blanks and spaces whereon Assistant Controller Taylor has requested them to record the exact disposition which they make of all time spent in the interests of the university." The assistant controller states that he desires these data for the purpose of using them "as

a basis for pro-rating salaries to the various classified functions"; but, after supplying a formidable array of blanks to be filled with this end in view, he winds up with a request for information concerning "Contributory Activities," the giving of which is optional. These include the number of hours spent on "research work carried on personally by the instructor," and certain other things which, like this, "are of a quasi-private nature." The assistant controller recognizes that the variations in such data due to the personal equation "would make impracticable the direct use of these figures for the purpose of distributing salaries," but nevertheless he is apparently of the opinion that they would be a comfortable thing to have, and so he asks for them. And quite right, too; for the optional of to-day may be the compulsory of to-morrow, and it is well to "get a line" on these professor people, even if you can't pin them down to exact facts and figures.

In sober truth, this news from Harvard is a very serious matter. It touches the very vitals of the professor's calling. It ought to bring out from the Harvard faculty, and especially from the men of light and leading in that faculty, an impressive protest; and the most impressive form the protest could take would be that of a dignified but firm refusal to comply with the demand made upon them. For what is at stake at Harvard is nothing less than the whole character and status of the American professorate. To be a university professor has hitherto meant, in this country, as in all the world, to give to the university yourself—your personality, your talent, your capacity to interest, to instruct, to inspire. Many professors have, to be sure. fallen woefully short of fulfilling this ideal; many have been deficient in ability, many in character. But the one great thing that has made the calling attractive to the best who are in it has been that this was the plane on which it was understood to rest. It offers none of the glittering material rewards of other vocations; it seldom holds forth the allurement of fame. In this country, its dignity has been far below that which belongs to it in Europe, thanks to an exaltation of the idea of management and administration elsewhere unknown; but the recognition of the personal nature of the professor's work, of a distinctively personal measurement of his value, has never been abandoned. It is Agassiz, or Child, or Martin, or Gibbs, or Norton, or Gildersleeve—not so many hours of their labor—that Harvard, or Yale, or Johns Hopkins has had the good fortune to possess; and every faithful and competent professor has a right to feel that the same is true of him in his degree. But how long would that feeling survive under a system which required each professor to make report of every hour that he spent upon his work, and have his pay doled out to him accordingly?

It is easy to accuse those who object to the introduction of this efficiency nostrum of being reactionaries—upholders of the doctrine that whatever is is right. But it is still easier to reply to the accusation. Not because our universities and colleges are all that they ought to be, but because the proposed remedy is a crude and barbarous one, do we reject that remedy. We ought to have more competent teachers, we ought to have more inspiring leaders of research; but we shall not get them by means of time checks or card catalogues. The American professor is already far more subject to managerial control than his fellow in Germany or France; but it is in America, and not in Germany or France, that the cry of incompetent professors and inefficient instruction is continually heard. What is needed, above all things else, is to make the professorship attractive to superior men—men of originality, men of power, men of enthusiasm. When you have got all your time-card and efficiency-measure mechanism going, you may be able to compel every professor to come up to a certain standard; but you can not compel the men whom you ought to have as professors to enter the calling. You may get the same amount of "results" out of the faculties for less money, or a greater amount for the same money, so far as "results" can be measured by your mechanical methods; but what you have lost you will never be able to measure. And what shall it profit the uni-

versity to have gained countless student-hours and experiment-units and to have lost what is highest and best in it?

* * * * * *

President Lowell has sent to the members of the Harvard faculty a statement which amounts to something like a repudiation of the preposterous circular of inquiry issued several days ago in the name of the assistant controller of the university. A more complete repudiation would have been more welcome, but it should be safe to assume that Dr. Lowell's statement that "answers were intended to be wholly voluntary" and that "the recent circular was issued under a misunderstanding" means the end of this folly. The episode is one that Harvard should be glad to forget, except in so far as it drew out—as it did, though we are not informed as to what extent—threats of resignation on the part of men who had a proper conception of the professor's calling. It is humiliating to think that such a protest should have been made necessary at our country's most distinguished seat of learning; but as it has happened, we trust that the feeling of self-respecting professors has been made so manifest as to preclude the possibility of any resurrection of the foolish scheme.—New York *Evening Post.*

SCIENTIFIC BOOKS

Methods in Chemical Analysis Originated or Developed in the Kent Chemical Laboratory of Yale University. Compiled by Frank Austin Gooch, Professor of Chemistry and Director of the Kent Chemical Laboratory in Yale University. 1912. New York, John Wiley & Sons; London, Chapman & Hall, Ltd. Pp. xii + 536. Price $4 net.

In his prefatory note the author states that "the object of this volume is to present the principal results reached by workers in the Kent Chemical Laboratory of Yale University in the investigation and development of methods in chemical analysis." As a rule, only those procedures are included which have been definitely proven to be useful, and the experimental data given are those immediately related to the facts stated. Copious references to original papers render further information regarding details, discussions and variations of procedure easily accessible if library facilities are available.

The subject matter is divided into twelve chapters, the first of which deals with "Appliances and General Procedure," the second with "The Alkali Metals," the third with the copper group, and so on, following the groups in the order of increasing valence across the periodic table.

The book is in no sense a text-book, nor is it of the character of a work for general reference with respect to methods of chemical analysis. It is, rather, a bringing together of abstracts of papers, all emanating from this laboratory so well and widely known for its contributions to chemical literature in this important field, but published in many journals throughout a long series of years. As such, it is a most remarkable compilation and can not fail to be of service to those in search of reliable analytical procedures, although its usefulness will be more like that of a "Beilstein" than that of a "Fresenius."

If it is recalled that the material is presented in concise, abstract form and yet occupies more than five hundred pages, it will be evident that the volume constitutes a striking tribute to the versatility and activity of Professor Gooch and his associates and a record which it would be exceedingly difficult for any other laboratory to parallel. The compilation is that of one who is a master in the art of clear, accurate and concise statement, but the compiler has characteristically repressed the evidences of his own share in the many investigations which made this volume possible. It is a book which should do much to uphold the "dignity of analytical chemistry," so warmly defended by the late Dr. C. B. Dudley, and one which may well incite others to renewed endeavor in this fundamental field of chemical science—a field which some have, of late, tended to regard as of inferior importance, but which happily shows signs of again asserting its claims to a fair share of recognition.

H. P. Talbot

Introduction to the Rarer Elements. By Philip E. Browning. Third edition, thoroughly revised. New York, John Wiley & Sons. 1912. Pp. xii + 232.

Our knowledge of the rarer elements has been considerably extended since 1908, when the second edition of "Browning" appeared. While the general scheme of the work remains the same as in the two previous editions, the author has made many changes and additions throughout: for instance, the chapter on qualitative separation has been extended by including new analytical diagrams, working directions, and notes; the chapter on technical applications has been much improved by the addition of considerable material; and a table of spectroscopic lines and plates illustrating typical spectra have been added. The revision has been quite thoroughly done. For the first time the work has been well indexed; this improvement in itself greatly enhances the usefulness of the book.

Among the omissions may be noted the following: The test for the platinum metals (except osmium and ruthenium) devised by Curtman and Rothberg (this is the most delicate chemical test for platinum); and the conduct of the platinum metals toward various gases (Phillips, *Am. Phil. Soc.*, March 17, 1893).

It would be advisable in later editions to give the original references to the literature on technical applications, especially to the patents; and to include a complete bibliography of the treatises on the rarer elements, if any bibliography is given.

Charles Baskerville

Light, Photometry and Illumination. A thoroughly revised edition of "Electrical Illuminating Engineering." By William Edward Barrows, Jr., B.S., E.E., Professor of Electrical Engineering, University of Maine. New York, McGraw-Hill Book Company. 1912. Pp. ix + 335.

Some of the science, and most of the art, of illumination is still in a decidedly unsettled state, and he who wishes to write a text-book on the subject has a narrow course to sail between the Scylla of obsolescent matter and the Charybdis of controversial discussion. Professor Barrows apparently has more fear of the first danger; at any rate, he has in several parts of his new text gone perilously near to the second. A considerable part of the book is made up of quotations and passages adapted from recent papers. As a résumé of important articles of the last few years the work is useful, and its value is augmented by the care which has been taken to give references to the original authorities. By copious use of quotations the author to some extent disarms criticism and shifts responsibility to the original authors, but for purposes of instruction the book would be more valuable if some of the lengthy quotations were replaced by a digested presentation of the problems to be met and the facts supposed to be established.

The treatment of radiation which serves as an introduction to the book is characterized by a looseness of expression which can not fail to produce hazy ideas in the mind of the student. As examples may be mentioned the statement that "at wave-lengths greater than those of red light the energy radiated is in the form of heat" (p. 1), and the naïve criticism of the bolometer because it "is apt to indicate the heat rays rather than the luminous rays" (p. 93).

Even more serious are certain misstatements of fact, *e. g.*, "since the radiation varies as the fourth power of the temperature, it is evident that the greatest efficiency of radiation will be obtained at the highest temperatures," and "it follows from the above that the efficiency of the source as an illuminant will vary greatly with the temperature" (p. 4). These statements precede any mention of the real cause of the increase in efficiency, that is, the shifting of the radiation toward shorter wavelengths with rise of temperature.

The discussion of the Luminous Equivalent of Radiation in Chapter III. is anything but clear. Its vagueness is due in part to the promiscuous use of terms without definitions,

but one can hardly avoid the conclusion that the author himself had no very sharply cut ideas associated with the various terms. It is to be regretted that the table of "reduced luminous efficiencies" taken from Ives is not accompanied by a quotation to explain the significance of this important conception and its relation to the older ideas of luminous efficiency and the mechanical equivalent of light.

On page 64 the statement is made that Houstoun's and Strache's specifications of a standard of illumination in terms of radiation having a spectral distribution corresponding to the sensibility curve of the normal eye "consist in specifying the light standard by the least quantity of radiated energy which can produce the standard intensity." This is not true, and the error is especially striking because immediately preceding it is a whole page of discussion of "the most efficient possible radiation" as the basis of the Ives standard.

It should be noted that the luminosity curves given on pages 42 and 98 are not in the form at present accepted, since they were plotted from Koenig's data without correction for the dispersion of his prism. Incidentally the ingenious hypothesis of Dr. Bell that errors in heterochromatic photometry with the equality of brightness photometer are due to "the shifting of colors by contrast along the luminosity curve" can not be considered so well established as the author seems to think.

In view of the importance of the relation of the old English candle to the international candle now generally accepted as the unit of intensity in England and France as well as the United States, it is unfortunate that Professor Barrows has felt it necessary to give a new value for the old unit (p. 61) and has thus helped to perpetuate the mistaken impression that the value of the English candle has been intentionally changed. The fact is that the present unit is exactly the same as the old English candle to the degree of accuracy with which the British authorities could determine the proper average value of the old unit. Since there have been no British standard sperm candles made under authority of law since 1898, and the German candle was superseded by the Hefner 25 years ago, it is to be hoped that makers of text-books will some time accept the simple ratios of units now in use and will cease to give confusing tables of uncertain historical ratios.

The middle portion of the book gives descriptions of a great variety of photometrical apparatus and a very complete exposition of various methods of calculating light flux and illumination. A number of tables summarize the published empirical data of the best-known illuminating engineers and are valuable as an approximate indication of the results to be expected from various types of illuminants and methods of installation. In an appendix are given several tables of constants which are useful in the calculation of illumination.

Two chapters devoted to principles of interior and of street illumination are largely quoted from papers of Mr. A. J. Sweet. Of 22 pages dealing with street lighting, 17 are copied verbatim. Since Mr. Sweet's papers were not intended to be text-books, it is no disparagement of his work to say that the chapter covers the subject very inadequately. That the opinions so fully quoted are not universally accepted is shown in a curious way. Mr. Sweet takes twelve pages to establish the conclusion that an angle of about 65° from the vertical "must be taken as a line of absolute prohibition" for high intensity in street lamps. "If it is to be exceeded at all, it may as well be entirely ignored," he says, and on the opposite page Professor Barrows gives a curve for a lamp which has 75 per cent. of its maximum candle-power as high as 80° from the vertical, with the statement that it "closely approximates the ideal conditions"!

The book as a whole would have been much improved by a thorough editing, for in many passages the language is crude, to say the least. It is marred also by an unusual number of typographical errors. Nevertheless, in spite of the many weak points, it must be granted that Professor Barrows has collected a large amount of valuable material, and it is to be hoped that future editions will enable

him to remedy defects both of form and of substance.

E. C. CRITTENDEN

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SPECIAL ARTICLES

THE EFFECT OF ANESTHETICS UPON PERMEABILITY

THERE is much uncertainty as to the mode of action of anesthetics and particularly as to their effect upon permeability. While some writers hold that anesthetics increase permeability, others take the opposite view.[1] To clear up this confusion appears to be a necessary step toward a theory of anesthesia.

A definite solution of this problem seems to have been attained in the cases here described. This result is due to the employment of quantitative methods without which it would not have been possible.

The experiments were made by measuring the conductance of living tissues of a marine plant, *Laminaria*. Under the conditions of the experiment an increase or decrease of conductance signifies a corresponding increase or decrease of permeability.[2]

The anesthetics were mixed with sea water and sufficient concentrated sea water was then added to make the conductivity equal to that of sea water. The material was then placed in the mixture and its conductance was measured at frequent intervals.

Material having resistance of 1,000 ohms[3] was placed in a mixture of 990 c.c. sea water plus 10 c.c. ether, to which was added sufficient concentrated sea water to make its conductivity equal to that of ordinary sea water. In the course of 10 minutes the resistance rose to 1,100 ohms: in the next 10 minutes it fell to 1,070 ohms; in 20 minutes more to 1,020 ohms, and in 20 minutes more to 1,000 ohms. In the next 20 minutes it dropped to 990 ohms, at which point it remained stationary for a long time. Subsequently it decreased very slowly, but at exactly the same rate as the control which remained in sea water during the experiment. After 24 hours it had the same resistance as the control.

In order to find out approximately what part of the resistance is due to the living protoplasm the tissue was killed at the end of the experiment by adding a little formalin: after rinsing well in sea water the resistance was 320 ohms. This represents the resistance of the apparatus and dead tissue; on subtracting it from the resistance previously given we obtain approximately the resistance due to the living protoplasm. This may be called the *net resistance* while the resistance before subtraction may be called the *gross resistance*. In this experiment, therefore, the net resistance before treatment with ether was $1{,}000 - 320 = 680$ ohms and the net conductance $1 \div 680 = .00147$ mho. The loss in net conductance due to ether is 13 per cent., which means a decrease of permeability amounting to 13 per cent.

It is evident that this decrease of permeability is completely reversible and involves no injury. The fact that after the resistance has fallen to a stationary point it is 10 ohms below the starting point does not indicate injury, but only an increase in the conductivity of the solution due to the evaporation of the ether.

In another series of experiments the effects of the evaporation of the anesthetic were avoided by constantly renewing the solution by means of a steady current. It was then found that the resistance, after rising rapidly to a maximum, remained stationary for a long time (often for two hours or more) at the maximum point, afterward falling slowly to the normal. This more prolonged exposure to the anesthetic seemed to produce no injurious effects.

In these experiments the amount of ether in the solution was 1 per cent. by volume. Smaller amounts of ether produced less effect:

[1] Cf. Höber, "Physikalische Chemie der Zelle und der Gewebe," Dritte Auflage, 1911, pp. 219, 223, 489; R. Lillie, *Am. Jour. Physiol.*, 29: 372, 1912; 30: 1, 1912; Lepeschkin, *Ber. d. bot. Ges.*, 29: 349, 1911.

[2] The method has been described in SCIENCE, N. S., 35: 112, 1912.

[3] All the figures in this paper refer to readings at 18° C.

below 0.2 per cent. little or no effect was observable.

Higher concentrations of ether give a very different result. With 3 per cent. by volume of ether the resistance rises very rapidly to a maximum (which is about the same as when 1 per cent. is used) and then falls very rapidly. But instead of stopping when the normal is reached the resistance continues to fall rapidly until death ensues. If the concentration of ether be increased the period during which the resistance remains above the normal becomes shorter until finally it becomes impossible to detect it even when readings begin 30 seconds after placing the tissue in the anesthetic. There is a corresponding increase in the rapidity of the fall of resistance and of the onset of death.

The decrease of permeability observed in these experiments may be easily and quickly reversed by placing the tissue in sea water. Is this also the case with the increase in permeability? This was tested in the following manner: The material was allowed to remain in the anesthetic until its resistance had fallen about 100 ohms below the normal (*i. e.*, below the resistance it had before being exposed to the anesthetic). It was then replaced in sea water and readings were taken at frequent intervals; recovery would be shown by a rise in resistance.

No such rise in resistance was observed. The experiment was varied by replacing the tissue in sea water after the resistance had fallen only 50 ohms below the normal and also by choosing a concentration of ether which caused the resistance to fall very gradually. Even then there was but rarely any sign of recovery and this was of short duration and small in amount.

Similar results were obtained with chloroform, chloral hydrate and alcohol, but not at the same concentrations: the concentrations which correspond to 1 per cent. ether are approximately as follows: chloroform 0.05 per cent., chloral hydrate 0.05 per cent., alcohol 3 per cent.

Two distinct effects are observable in these experiments. One is a toxic effect evidenced by an increase in permeability, while the other involves a decrease of permeability. A very important question is, with which of these is the anesthetic action associated? Since the distinctive mark of an anesthetic is the reversibility of its action, it is not reasonable to suppose that this action is associated with an irreversible change in permeability. Such a change is in no way peculiar to anesthetics, but is common to all toxic substances. We are, therefore, forced to the conclusion that it is the reversible change, involving a decrease of permeability, which is associated with the anesthetic action.

The fact that typical anesthetics (ether, chloroform, chloral hydrate and alcohol) decrease the permeability of the tissue to ions is profoundly significant in view of the fact that the transmission of nervous and other stimuli is believed to depend on the movement of ions within the tissues. W. J. V. Osterhout

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PARTIAL SEX-LINKAGE IN THE PIGEON

That certain characters in pigeons are sex-linked is shown by the work of Staples-Browne,[1] Cole[2] and Strong.[3] Both Staples-Browne and Strong, however, encountered certain exceptions which I shall try to show are explicable on the assumption that there is in the female pigeon a pair of sex-chromosomes, between which crossing-over of the factors may occur.

Staples-Browne found that a white female crossed to a dark male produced all dark offspring, showing that white is recessive to dark. The reciprocal cross, viz., white male by dark female produced dark males and white females. So far, this last cross is a typical case of "criss-cross" inheritance, in which the recessive character entered the cross from the parent homozygous for the sex-differentiating factor, viz., from the male in this case.

Staples-Browne found, however, in this F_1, in addition to the white females, one dark fe-

[1] R. Staples-Browne, *Jour. Genetics*, June, 1912.

[2] L. J. Cole, Science, August 9, 1912.

[3] R. M. Strong, *Biol. Bull.*, October, 1912.

male, and Strong found three such dark females.

If in the female the sex-differentiating factor and the factor for plumage color are placed close enough together in the same chromosome to be linked, but not so close that the linkage is complete, "crossing-over" would cause the two factors which entered in the same member of the homologous pair of chromosomes to lie in different members and hence to segregate to different gametes.

If the sex-differentiating factor be M, then the formula for the male is MM and for the female Mm. Let the gene carried by the recessive white pigeon be w and the dominant form of that gene carried by the dark bird be W. The dark female would ordinarily form gametes of the types MW and mw, but would occasionally form gametes Mw and mW by crossing-over.

The gametes and their possible combinations would be as follows:

P_1	White ♂	Mw—Mw
	Dark ♀	Mw—MW—mw—mW
F_1	$\frac{Mw}{Mw}$	— white ♂ (exceptional)
	$\frac{Mw}{Mw}$	— dark ♂
	$\frac{MW}{mw}$	— white ♀
	$\frac{Mw}{mW}$	— dark ♀ (exceptional)

A measure of the linkage between the sex-differentiating factor and the factor for plumage color would be the ratio of crossovers to the total number of individuals which might show crossing-over, viz., 4:59 or 7 per cent.

It should be pointed out that "partial-sex-linkage" signifies the linkage between the sex-differentiating factor and any other factor in the sex chromosome. In the case of *Drosophila* "sex-linked" means only that the factor is carried by the sex chromosome, and as yet no evidence has been obtained bearing on the degree of linkage of the sex-differentiating factor and any of the other factors thus far found in the same chromosome.

An explanation similar to the one here adopted for the pigeon may be given to Bateson and Punnett's[4] results with the silky fowl where partial-sex-linkage in the pigmentation is found. Three other cases of the same sort have been reviewed by Sturtevant,[5] viz., pink versus black eye in canaries, *Aglia tau* and its variety *lugens*, and *Pygæra anachoreta* and *P. curtula*.

Two cases of partial-sex-linkage in which the male is heterozygous for sex are reported. At least Sturtevant[6] so interprets the case of the dwarf guinea-pigs of Miss Sollas, and quite recently Doncaster[7] finds in cats that certain exceptions in the inheritance of coat-color may be due to partial-sex-linkage.

CALVIN B. BRIDGES
COLUMBIA UNIVERSITY

EXPERIMENTS SHOWING THAT COMPLETE RELATIVITY DOES NOT EXIST IN ELECTROMAGNETIC INDUCTION

IN the *Physical Review* for November, 1912, I described in detail some experiments which, taken together with earlier experiments by Faraday and others, establish the fact that complete relativity does not exist in electromagnetic induction. As a number of enquiries with reference to these experiments have been made, and as the subject of relativity is one in which great interest is taken by others as well as physicists, it seems desirable to give a brief account of the experiments in SCIENCE.

Two series of experiments were made, one without iron and the other with iron. In the first series a cylindrical condenser was mounted symmetrically in the approximately uniform magnetic field within a cylindrical electric coil coaxial with the condenser's armatures. The condenser, maintained at rest, was short-circuited, and the coil, tra-

[4] W. Bateson and R. C. Punnett, *Jour. Genetics*, August, 1912.

[5] A. H. Sturtevant, *Jour. of Exp. Zool.*, May, 1912.

[6] A. H. Sturtevant, *Am. Nat.*, September, 1912.

[7] L. Doncaster, SCIENCE, August 2, 1912.

versed by an electric current, was rotated about its axis at uniform speed. The inner armature of the condenser was then insulated from the outer, after which the magnetic field was annulled and the rotation stopped. The inner armature was then tested for electric charge.

The second series of experiments was similar to the first except that the magnetic field was produced by two symmetrical electromagnets mounted coaxially with the condenser and rotated together at the same speed.

In neither series of experiments was there detected upon the condenser any charge as great as the experimental error (see below).

Now it is an immediate consequence of the classical experiments of Faraday and others upon the electromotive force developed in a metal disc rotating in a magnetic field produced by a *fixed* electric coil or magnet, together with experiments of Blondlot,[1] H. A. Wilson,[2] and myself[3] upon the electric charges developed on adjacent conductors by the motion of insulators in magnetic fields produced by fixed coils or magnets, that, if the complete condenser and its short-circuiting wire had been rotated while the coil or magnets remained fixed, the armature tested would have received a charge equal to the continued product of the capacity of the condenser as it would be with air or free ether as dielectric, the magnetic flux through the space between the armatures, and the number of revolutions of the condenser per second. Moreover, it follows from the above mentioned experiments on insulators that if the condenser's dielectric is air, as in my own experiments, it is of no consequence whether the air rotates with the armatures or not.

It was thus easy to calculate the charge which would have been developed upon the condenser in each of my experiments for the same relative motion between it and the complete field-producing agent, but with this agent at rest and the condenser in motion.

The investigation proved conclusively that the condenser system, when it remained at rest and the agent producing the field rotated, received not more than a minute fraction of the charge it would have received for the same relative motion if the agent producing the field had been the part to remain at rest. Within the limits of error of the experiments —about 1.4 per cent. in the experiments with the electric coil, and about 1 per cent. in the experiments with the electromagnets—this fraction was zero.

The experiments appear to be *experimenta crucis,* in complete accord with the theory of Lorentz, but inconsistent with any theory based on complete relativity.

S. J. BARNETT
THE OHIO STATE UNIVERSITY

[1] *Journal de Physique,* 1902.

[2] *Phil. Trans.,* 1904.

[3] *Physical Review,* 1908.

THE AMERICAN SOCIETY OF NATURALISTS

THE thirtieth annual meeting of the American Society of Naturalists was held at Case School of Applied Science, Cleveland, Ohio, on January 2, in connection with the meetings of the American Society of Zoologists, the American Association of Anatomists, the Botanical Society of America, the American Society of Physiologists, the American Society of Biological Chemists, the American Phytopathological Society, and the various sections of the American Association for the Advancement of Science.

The morning session was devoted to a symposium on Adaptation, with the following speakers:

M. M. Metcalf (Oberlin College): "The Origin of Adaptations through Selection and Orthogenesis."

Burton E. Livingston (Johns Hopkins University): "Adaptation in the Living and Nonliving."

George H. Parker (Harvard University): "Adaptation in Animal Reactions."

Henry T. Cowles (University of Chicago): "The Adaptation Viewpoint in Ecology."

Alfred G. Mayer (Carnegie Institution of Washington): "Adaptation of Tropical Animals to Temperature."

Albert P. Mathews (University of Chicago): "Adaptation from the Standpoint of the Physiologist."

Lawrence J. Henderson (Harvard University): "The Fitness of the Environment; an Inquiry

into the Biological Importance of the Properties of Matter.''

These papers will appear in the *American Naturalist.*

The afternoon session was for the reading of papers on Genetics, the program being as follows:

R. M. Strong (University of Chicago): ''Sex-linked and Sex-limited Inheritance.'' Read by title.

L. J. Cole (University of Wisconsin): ''The Reversionary Blue Pigeon.''

B. M. Davis (University of Pennsylvania): ''The Behavior of Hybrids of *Œnothera biennis* and of *Œ. grandifloris* in the Second and Third Generations.''

George H. Shull (Carnegie Institution of Washington): (1) ''Duplicate Genes for *Bursa bursa-pastoralis.*'' (2) ''A Sex-limited Character in Plants.''

R. A. Emerson (University of Nebraska): ''The Inheritance of a Recurring Somatic Variation in Variegated Ears of Maize.''

C. M. Child (University of Chicago): ''The Fundamental Reaction System and its Significance in Inheritance.'' Read by title.

A. F. Shull (University of Michigan): ''Inheritance of Egg Characters and the Sex-ratio in *Hydatina senta.*''

J. A. Detlefsen (University of Illinois) (introduced by W. E. Castle): ''Studies of a Cross between *Cavia rufescens* and the Guinea-pig.''

K. Foot and E. C. Strobell (New York City): ''Results of Crossing Two Hemipterous Species with Reference to the Inheritance of an Exclusively Male Character, and its Bearing on Modern Chromosome Theories.''

H. K. Hayes (Connecticut Agricultural Experiment Station): ''The Inheritance of Certain Quantitative Characters in Tobacco.''

The annual dinner of the society was held on the evening of January 2, at the Colonial Hotel, one hundred and twenty-four being present. The president's address by Professor E. G. Conklin, on ''Heredity and Responsibility,'' was published in SCIENCE for January 10.

The following new members were elected: Helen D. King, Wistar Institute; Lewis R. Cary, Princeton University; E. Newton Harvey, Princeton University; Ethel M. Browne, Princeton University; Aute Richards, University of Texas; Otto F. Kampmeier, University of Pittsburgh; C. G. Crampton, Massachusetts Agricultural College, Amherst, Mass.; H. F. Roberts, Manhattan, Kansas; F. W. Bancroft, Rockefeller Institute; Caswell Grave, Johns Hopkins University, and H. L. Wieman, University of Cincinnati.

The following officers were elected for 1913:

President—Ross G. Harrison, Yale University.

Vice-president—E. M. East, Harvard University.

Secretary—B. M. Davis, University of Pennsylvania.

Treasurer—J. Arthur Harris, Station for Experimental Evolution, Cold Spring Harbor.

Additional Members of the Executive Committee—A. P. Mathews, University of Chicago, and A. L. Treadwell, Vassar College.

A. L. TREADWELL,
Secretary for 1912

THE AMERICAN MATHEMATICAL SOCIETY

THE nineteenth annual meeting of the American Mathematical Society was held at Cleveland, Ohio, in affiliation with the American Association for the Advancement of Science, on Tuesday–Thursday, December 31–January 2. The usual winter meeting of the Chicago Section was merged in this annual meeting. Separate sessions of the society were held on Tuesday morning, Wednesday morning and afternoon and Thursday morning. On Tuesday afternoon there was a joint meeting of the society with Sections A and B of the American Association, the Astronomical and Astrophysical Society of America and the American Physical Society. At this joint meeting the following papers were read:

E. B. Frost, vice-presidential address, Section A: ''The spectroscopic determination of stellar velocities, considered practically.''

R. A. Millikan, vice-presidential address, Section B: ''Unitary theories in physics.''

A. G. Webster: ''Henri Poincaré as a mathematical physicist.''

E. J. Wilczynski: ''Some general aspects of modern geometry.''

L. A. Bauer: ''Cosmical magnetic fields.''

G. E. Hale: ''Preliminary note on an attempt to detect the general magnetic field of the sun.''

The attendance at the several sessions of the society included sixty-two members. The chair was occupied in succession by Professors E. W. Davis, E. H. Moore, G. A. Bliss, and after the annual election by the president-elect, Professor E. B. Van Vleck. The following new members were elected: E. W. Chittenden, University of Illinois; C. S. Cox, Mulberry, Fla.; S. D. Killam, University of Rochester; J. T. Rorer, Philadelphia, Pa.; R. M.

Winger, University of Illinois. Sixteen applications for membership were received.

At the annual election, which closed on Thursday morning, the following officers and other members of the council were chosen:

President—E. B. Van Vleck.
Vice-president—M. W. Haskell, B. O. Peirce.
Secretary—F. N. Cole.
Treasurer—J. H. Tanner.
Librarian—D. E. Smith.
Committee of Publication—F. N. Cole, E. W. Brown, Virgil Snyder.
Members of the Council—F. C. Ferry, W. B. Ford, R. C. Maclaurin, Jacob Westlund.

The treasurer's report shows a balance of $9,684.92, including the life membership fund of $4,483.69. Sales of publications during the year amounted to $1,730.94. The total membership of the society is now 680, including 64 life members. The total attendance of members at all meetings during the past year was 336, the number of papers presented 179. The library shows a marked growth, the number of catalogued volumes being now 4,560. Much of the increase is due to the generous gifts of several hundred volumes by Dr. Emory McClintock and Dr. G. W. Hill, ex-presidents of the society.

The following papers were read at this meeting:

R. D. Carmichael: "On the numerical factors of the arithmetic forms $\alpha^n \pm \beta^n$."

R. D. Carmichael: "On non-homogeneous linear equations with an infinite number of variables."

R. D. Carmichael: "Note on Fermat's last theorem."

W. A. Hurwitz: "Mixed linear integral equations of the first order."

H. Galajikian: "On certain non-linear integral equations."

W. A. Hurwitz: "On Green's theorem for the plane."

Arnold Emch: "On some properties of closed continuous curves."

G. A. Miller: "The product of two or more groups."

J. E. Rowe: "Three or more rational curves in collinear relation."

F. R. Sharpe and F. M. Morgan: "Quartic surfaces invariant under periodic transformations."

H. M. Sheffer: "A set of postulates for the Boolean algebra."

J. R. Conner: "The rational sextic curve and the Cayley symmetroid."

J. R. Conner: "Multiple correspondences determined by the rational space septimic."

L. E. Dickson: "Finiteness of the odd perfect and primitive abundant numbers with a given number of distinct prime factors."

L. E. Dickson: "Amicable number triples."

J. L. Coolidge: "A study of the circle-cross."

G. A. Bliss: "The relation satisfied by two dependent functions near a point at which both are singular."

J. A. Eiesland: "On the algebraic curves of a tetrahedral complex and the corresponding surfaces conjugate to it."

E. H. Moore: "On nowhere negative kernels."

Daniel Buchanan: "Oscillations near one of the isosceles triangular solutions of the three-body problem."

Peter Field: "On constrained motion."

G. C. Evans: "On the reduction of certain types of integro-differential equations."

J. A. Caparo: "Hyperspace and the non-euclidean geometry of four dimensions."

Jacob Westlund: "On the factorization of rational primes in cubic cyclotomic number fields."

E. L. Dodd: "An erroneous application of Bayes's theorem to the set of real numbers."

E. L. Dodd: "The validity of Bertrand's approximation leading to the probability integral."

Edward Kasner: "Equitangential trajectories in space."

C. J. Keyser: "Concerning multiple interpretations of postulate systems and the 'existence' of hyperspaces."

E. J. Wilczynski: "On a certain completely integrable system of linear partial differential equations."

L. C. Karpinski: "Algebra in the Quadripartitum numerorum of Johannes de Muris."

L. C. Karpinski: "Hindu numerals among the Arabs."

H. B. Phillips: "Directed integration."

Joseph Lipke: "Geometric characterization of isogonal trajectories on a surface."

J. B. Shaw: "Integral invariants of general vector analysis."

J. B. Shaw: "On non-linear algebras."

D. R. Curtiss: "Proofs of certain formulas suggested by Laguerre's work in the theory of equations."

Arthur Ranum: "On the projective differential classification of n-dimensional spreads generated by ∞^1 flats."

I. M. Schottenfels: "Proof that there is but one simple group of order $7!/2$."

L. P. Eisenhart: "Certain continuous deformations of surfaces applicable to quadrics."

E. V. Huntington: "A set of independent postulates for 'betweenness.'"

A. B. Frizell: "Some terms in the expansion of the infinite determinant."

T. H. Gronwall: "On Weierstrass's preparation theorem."

T. H. Gronwall: "On series of spherical harmonics (second paper)."

Cora B. Hennel: "Transformations and invariants connected with linear homogeneous difference equations and other functional equations."

Harris Hancock: "Problems in arithmetical geometry."

Harris Hancock: "Generalization of a theorem due to Liouville or to Dedekind, with applications to the geometry of numbers."

W. D. MacMillan: "A proof of Wilczynski's theorem."

W. D. MacMillan: "On Poincaré's correction to Bruns's theorem."

W. B. Fite: "Some theorems concerning groups whose orders are powers of a prime."

L. L. Smail: "Some generalizations in the theory of summable divergent series."

C. E. Love: "On the asymptotic solutions of linear differential equations."

Virgil Snyder: "Algebraic surfaces invariant under an infinite discontinuous group of birational transformations (second paper)."

L. L. Silverman: "On the equivalence of definitions of summability."

R. M. Winger: "Self-projective rational curves of the fourth and fifth order."

The next meeting of the society will be held at Columbia University on Saturday, February 22.

F. N. COLE,
Secretary

THE OHIO ACADEMY OF SCIENCE

THE twenty-second annual meeting of the Ohio Academy was held at Ohio State University, Columbus, O., on November 28, 29 and 30, the president of the society, Professor Bruce Fink, of Miami University, presiding. On Thursday evening an informal reception was given at the Ohio Union Club, where assignment of rooms were made to the visiting members, and a pleasant social period was thoroughly enjoyed by all. The sessions on Friday and Saturday were in the general lecture room of the Physics Building.

The address of President Fink on "Botanical Instruction in Colleges" occurred at 1:30 P.M., Friday, while the evening was given up to a dinner and smoker.

The complete program follows:

"New and Rare Plants added to the Ohio List in 1912," J. H. Schaffner.

"Some Applications of Biometry to Agricultural Problems," A. G. McCall.

"The Influence of Topography on Bird Migrations," Lynds Jones.

"Experiments in Fertilization," R. A. Budington.

"Heredity (Eugenics)," W. F. Mercer.

"The Ohio Biological Survey," Herbert Osborn.

"Notes on some Rare Ohio Mosses," Clara G. Marks.

"Effect of Road Oil on Rubber Tires," Errol L. Fox and Chas. P. Fox.

"Notes on Ohio Oaks," W. R. Lazenby.

"The Mississippian-Pennsylvanian Unconformity and the Sharon Conglomerate," G. F. Lamb.

"The Primary Motor Column of the Central Nervous System of *Amblystoma* and its Relation to the Motor Nerves," C. E. Coghill.

"Note on the Tactile Reactions of some Orb-weaving Spiders in their Webs," W. M. Barrows.

"*Balanoglossus* and the Origin of the Central Nerve Tube in Vertebrates," M. M. Metcalf.

"Additions to the Cedar Point Flora," E. L. Fullmer.

"Seeds and Seedling of some Forest Trees," W. R. Lazenby.

"Lorain County Myxomycetes," F. O. Grover.

"The Cerebral Ganglia of the Frog Tadpole," F. L. Landacre and Marie F. McLellan.

"An Ancient Lake in Ohio with Unlevel Shorelines," Geo. D. Hubbard.

"Terraces associated with the Terminal Moraine near Delafield, Wisconsin," C. G. Shatzer.

"An Ecological Study of Forest Types near Columbus," F. B. H. Brown.

"Algæ of Lorain County, Ohio, with Notes on their Distribution," Susan P. Nichols.

"Yerba Mate (Paraguay Tea)," Chas. P. Fox.

"Mississippian Conglomerates in Northern Ohio," G. F. Lamb.

"Charts illustrating Feeble-mindedness," W. F. Mercer.

"A Supernumerary Appendage in *Otocryptops sexspinosus*, and a Theory of Heterorhythmic Development," L. B. Walton.

"The Soaring Flight of Birds," Lynds Jones.

"The Aquarium at the Naples Station," Stephen R. Williams.

"Geography of the Balkan Peninsula" (lantern slides), N. M. Fenneman.

"A Botanical Survey of the Sugar Grove Region" (lantern slides), Robert Griggs.

"The Fauna of the Conemaugh Formation," Clara G. Marks.

"A Preliminary Report on the Crayfishes of Ohio," C. I. Turner.

"Induced Modifications in the Pigment Development of Spelerpes Larvæ," A. M. Banta.

"Review of the Genus *Dero* (Aquatic Oligochates) with a Description of Two New Species," L. B. Walton.

"The Composition of a Typical Prairie," J. H. Schaffner.

"A List of Plants Collected in Cuyahoga County and New to the County or to Ohio," Edo Claassen.

"The Effects of Changes in Sea Beds on the Fauna and Lithology of the Richmond Period," G. M. Austin.

"The Application of Physics to Agriculture," A. G. McCall.

"The Resistance of Aluminum Oxide Films," H. E. Graber.

"The Differentiation of Diffraction Effects from the Extra Transmission of Electric Waves," C. R. Weinland.

"The Spectrum of Cored Carbons," C. D. Coons.

"The Effect of a Constriction in a Discharge Tube," R. F. Earhart.

"The Production of Light by the Firefly," C. R. Fountain.

"The Hall Effect and Allied Phenomena in Magnetic Alloys," A. W. Smith.

"Twist in Nickel and Steel Rods due to a Longitudinal Magnetic Field," S. R. Williams.

"The Effects of Temperature and Potential on the Thermionic Emission Heated Wires," Charles Sheard.

"The Scattering of Gamma Rays by Matter," S. J. Allen.

"Some Peculiarities of the High Frequency Graphite Arc," A. D. Cole.

DEMONSTRATIONS

Charts showing Distribution of Mitosis in the Central Nervous System of *Amblystoma* as Correlated with Functional Development, G. E. Coghill and S. W. Camp.

A Supernumerary Appendage in *Otocryptops sexspinosus* (Chilopoda), L. B. Walton.

Fine Crystals of Hopeite and of Tarhuttite, Two Rare Hydrous Phosphates of Zinc from Africa, Geo. D. Hubbard.

Maps and Diagrams Illustrating an Ecological Study of Forest Types, F. B. H. Brown.

The committee on the State Biological Survey reported that a definite organization had finally been accomplished through the cooperation of twelve educational institutions of the state and that a limited fund would at once be available toward beginning the work. The survey will be in charge of the director, Professor Herbert Osborn, of Ohio State University, and an administrative board consisting of a representative from each cooperating institution. The report was accepted and the committee dismissed.

The society adopted resolutions expressing its sense of loss in the death of three members during the year, Dr. Joshua Lindahl, Dr. P. A. Hobbs and Dr. H. L. True. Dr. Lindahl served the society as its president in 1900, and during his residence in Ohio had always taken an active interest in the success of the academy.

A resolution requesting legislation along the following lines was also adopted:

Resolved, that it is the sense of this academy that the legislature of Ohio should pass a law designed to make it impossible for the insane, the feeble-minded and the confirmed criminals to propagate their kind. That to this end we commend to its attention and study the laws providing for sterilization already in force in six of the United States. That copies of this resolution be sent to the several county and city medical societies of Ohio, asking their cooperation in the accomplishment of this purpose.

After adopting additional resolutions expressing the appreciation of the society for the courtesies extended by the faculty and others connected with the university, and furthermore thanking Mr. Emerson McMillan, of New York, for his continued donations to the research funds of the society, the academy adjourned to meet at Oberlin next November.

A department of physics was organized and 21 new members added, making the total membership 214.

The following officers were elected for the coming year:

President—Professor L. B. Walton, Kenyon College, Gambier, Ohio.

Vice-presidents—(Zoology) Professor Charles Brookover, Buchtel College, Akron, Ohio; (Botany) Professor F. O. Grover, Oberlin College, Oberlin, Ohio; (Geology) Professor August Foerste, Dayton, Ohio; (Physics) Dr. T. C. Mendenhall, Ravenna, Ohio.

Secretary—Professor E. L. Rice, Ohio Wesleyan University, Delaware, Ohio.

Treasurer—Professor J. S. Hine, Ohio State University, Columbus, Ohio.

Librarian—Professor W. C. Mills, Ohio State University, Columbus, Ohio.

Executive Committee—(ex-officio) Professor L. B. Walton, Gambier, Ohio; Professor E. L. Rice, Delaware, Ohio; Professor J. S. Hine, Columbus, Ohio; (elective) Professor S. J. Allen, University of Cincinnati, Cincinnati, Ohio; Professor C. G. Shatzer, Wittenberg College, Springfield, Ohio.

Board of Trustees—Professor W. R. Lazenby, Ohio State University, Columbus, Ohio.

Publication Committee—Professor J. H. Schaffner, Ohio State University, Columbus, Ohio.

L. B. Walton,
Secretary

Gambier, Ohio,
December 4, 1912.